METAL INDUSTRY

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Industrial Trends

IN February last the Federation of British Industries carried out an enquiry among a sample of its membership in order to assess the present trends in British industry. A second enquiry similar to the first has recently been carried out covering the three months period to May 31 last and out of 850 firms who were contacted some 554 returned their questionnaire in time for analysis. The distribution of replies was broadly representative of the different types and sizes of companies within industry. On balance businessmen appear rather less optimistic than they were three months ago. Nevertheless the percentage of firms recording an increase in both home and export deliveries and in the rate of new orders is encouraging.

The results of this enquiry were as follows:— (i) Capital expenditure authorizations in 1958 compared with 1957 are expected to show somewhat general declines; (ii) three-fifths of the replies report that the labour situation is easier, and during the last three months both total employment and hours worked have tended slightly to decline; (iii) new orders have been tending to fall off and there has been a reduction in the length of order books; (iv) output has remained more or less steady, reductions being nearly balanced by increases; (v) raw material stocks have been reduced and stocks of finished goods are tending slightly to rise; (vi) in spite of rising costs, there has been a number of price reductions, 30 per cent of the replies reporting that prices had been reduced; (vii) over half the replies state that profit margins are being reduced, while nearly half report them as unchanged; very few (5 per cent) report rising profit margins; (viii) bearing in mind the different interpretations of the phrase "capacity utilization" a large proportion of companies (76 per cent) is recorded as working below capacity.

The results of this survey make interesting reading but they should be read in conjunction with the latest issue of The Treasury's Bulletin for Industry in which it is pointed out that the volume of exports from this country between 1955 and 1956 increased by 6 per cent, but between 1956 and 1957 they rose only by 2 per cent. The figure for the last quarter of 1957 was barely level and in the first quarter of this present year the figure was slightly lower. The British share of world trade has fallen from 21 per cent in 1953 to 18 per cent in 1957. In this period Germany increased its share from 13 per cent to 18 per cent, and Japan from 4 per cent to 6 per cent. The recovery, in part at the expense of the United Kingdom, of these two countries' export business from their post-war levels was only to be expected for a few years after 1950 but The Treasury Bulletin emphasizes that their gains are still continuing.

It is argued that the real test of the export drive lies in the condition of the balance of payments as a whole. Last year we had a good surplus and the indications are that we are again doing well this year. But the Bulletin goes on to say that if the U.K. is to take full advantage of all its opportunities and continue to provide international investment capital on the expected scale, as well as maintaining an effective means of exchange for much of the world's trade and payments, an even larger surplus is needed. Hence the need for more exports.

Out of the MELTING POT

Modest Programme

IN view of what they are aiming at, it is not really surprising that designers of aircraft, and even more so of rockets, when it comes to asking for materials, usually ask for what amounts to the moon or even the remoter planets. The materials they need must have remarkably high strength: weight ratios, which ratios should remain substantially constant when the materials are heated to remarkably high temperatures. Accustomed as one is to such optimistic demands, the five to ten year forecast of metals research requirements recently released by the American Aircraft Industries Association comes as a most pleasant change. The requirement set out in this forecast is that components in aircraft and missiles should be capable of efficient operation at temperatures of 2,000° F. for a few minutes' duration, and at 1,200° F. for prolonged exposure. According to the present-day views in the aircraft industry, the major emphasis should be directed towards the following: (1) Evaluation of the properties, corrosion resistance, ductility, heat-treatment, properties at sub-zero temperatures, and welding, brazing and fabrication of precipitation hardening semi-austenitic steels. (2) Evaluation of the properties and improvement in the fabrication of air-hardening stainless and alloy steels aimed at tensile strengths above 300,000 lb/in^2. (3) Completing the evaluation of sandwich and other panel constructions for high temperature use. (4) Continued development of various heat-resistant alloys of the iron, cobalt and nickel-base types. (5) Increasing the strength and reducing the cost of titanium. (6) Development of methods of protecting readily oxidizable materials, such as molybdenum, at elevated temperatures. (7) Development of beryllium metal or alloys. (8) Further development in the field of fibre metallurgy.

Overfeeding

IN spite of their frequent repetition, complaints about the volume of scientific and technical reading matter are still received with tolerance and, indeed, sympathy. While, on the one hand, little if anything appears to be done directly to reduce the volume or to modify the form of this matter with a view to facilitating the task of coping with it, these complaints have, on the other hand, stimulated a great deal of enterprise intended to reduce the task by way of concentration, dehydration or predigestion of the matter to be dealt with. The stage has now, in fact, been reached when some complaints could with advantage be diverted from their original target and redirected at some of this benevolent enterprise, which is exhibiting signs of getting out of hand and running riot, if indeed, it has not already done so. While such excessive enterprise in the space that lies, or rather can be created, between readers and original literature is becoming apparent everywhere, it is particularly noticeable in and around the field of Russian scientific and technical literature. There was a time when, if one knew no Russian or was unable to get hold of the original journals, one simply came across the abstracts in the course of perusing one's favourite abstract journal, and then, if it appeared worth while, set about arranging for a translation of one or other of the originals. Admittedly, one's favourite abstract journal may not have been as thorough as it could have been in covering the relevant Russian literature, but that was something that could have been corrected without much trouble. To-day, anybody showing interest in Russian scientific and technical literature is liable to come across items of interest in lists of translated titles, abstracts of the same articles in his favourite abstract journal, abstracts of the translations of the same articles, cover-to-cover translations of the Russian journals containing these articles, references to these articles in various lists of translations of Russsian articles and, occasionally, translations of these articles in the form of official reports for which one visualizes their having been obtained by cloak-and-dagger methods and released after the unavoidable much-delayed security clearance. An improvement of the above indigestible state of affairs is admittedly not easy to suggest.

Tests Under Control

THE various tests used to determine the mechanical properties of solids, including metals and alloys, are so familiar that their nature and their limitations are hardly ever brought to mind and considered. Their nature, to begin with, is determined by the fact that they were developed to meet engineering requirements. Consequently, although their results are usually described as the mechanical properties of metals, they tell us more about the mechanical behaviour of metals than about metals. Their limitations are due to the restricted number of straining movements it is normally possible to employ, and to the fact that in the common methods of applying the stress, the test piece itself must be depended upon to transmit the stress. The deformation produced in the interior of the test piece, therefore, depends not only on the mechanical action applied to the boundary, but also on the ability of the test piece to transmit this deformation. Some of these limitations are overcome in a method in which the material to be tested is spread in a thin layer on a substrate which is itself deformable, e.g. rubber, and which, by being deformed in various ways, can serve to transmit corresponding deformations to the layer of material to be tested, provided the two materials adhere sufficiently. Various materials, including vacuum deposited metals, have been studied by this method. Apart from the variety of deformations that can be imposed by this method, the latter is particularly useful for the examination of events preceding failure, since failure is caused to occur not at one place, the exact site of which is unpredictable, but regularly throughout the sample in an easily controllable manner. Among the interesting initial results that have been obtained using the above method is the observation of flow lines in the direction of the lines of zero elongation. This fact may link up with previously reported observations to the effect that, in tension tests on wide flat specimens cut from cold rolled metal sheet, fracture occurs along an oblique plane perpendicular to the flat sides of the test piece and inclined at an angle of approximately 55° to the axis of the test piece, the fracture being clearly not a shear failure. Another interesting observation is the common features, e.g. fatigue and relaxation of work-hardening by vibrations, exhibited by such diverse materials as dry powders, pastes, polymers and vacuum deposited metals when tested by the new method.

Skinner

FACTORS AFFECTING USE OF THE HOT TOP METHOD

Pouring Semi-Continuous Cast Ingots

By R. A. JONES and V. KONDIC, B.Sc., Ph.D.

FEW casting processes have attracted so much interest within recent years as the process of continuous and semi-continuous casting of ingots. It is quite easy to understand such wide interest when one remembers that we live in a metal age in which more than 90 per cent of all metals used start their life story in an ingot form. Books have been written on the patent literature of continuous casting alone—and yet one of the interesting points of the situation to-day is that but a few of these processes are, in fact, used in industry. Further general observation that can be made about the present ingot casting practices is that all batch methods of ingot casting have not been superseded by the semi-continuous or continuous methods, particularly for certain alloys. The object of the present article is to deal with some of the outstanding problems that have prevented wider application of the semi-continuous and continuous casting methods in some non-ferrous fields, and particularly to describe some more recent developments.

Ingot Size Factor

Perhaps the light alloy industry has adopted the semi-continuous casting process of the conventional vertical short water-cooled mould type more than any other alloy industry. But even for light alloys this method of casting cannot be readily applied for small sizes, i.e. less than 2 in. dia., and rolling slabs and similar small cross-sections. Such small sizes are difficult to pour, as well as presenting some metallurgical problems. The demand for such small cross-sections led eventually to the development of the Properzi, water-cooled wheel type continuous casting process for light alloys.

The problem of continuously casting small size ingots becomes even more formidable when changing from light alloys to copper-base alloys. Here, again, direct pouring methods are impracticable, and the method developed by Asarco, using a closed system, based on a graphite mould, obviates the need for pouring. However, graphite moulds have a short life, particularly when used for a semi-continuous instead of a continuous process. No information has been published as to whether the Asarco method is used for the brass group of copper alloys or aluminium bronzes. Thus, at present a producer of brass ingots ranging from small to intermediate sizes still depends mainly on the old-established batch methods of ingot production. This is true particularly of foundries with a smaller output, whilst some larger foundries have been successfully using the Junghans-Rossi fully-continuous type of ingot casting plant for comparatively large cross-section size ingots.

Alloy Characteristics Factor

In addition to the problem of ingot size, certain alloys present pouring difficulties of their own. Brasses are a good example of alloys of this type. When brass is poured in an open mould directly from the crucible, some dross forms in the mould, which is carried to the mould walls. This dross remains sticking in a water-cooled mould and, consequently, either tears up the ingot surface or leaves at the surface other types of imperfections. Thus, one of the possible advantages that should be gained by the brass ingot producer, i.e. a good-as-cast-ingot surface, would be, in effect, lost rather than gained when applying the continuous instead of the conventional batch ingot casting process. The possible economic or metallurgical advantages of semi-continuous and continuous casting of brass have not appeared so far to be attractive enough to a brass manufacturer, and hence the present brass ingot casting practice is basically still very much the same as that used before the development of continuous casting.

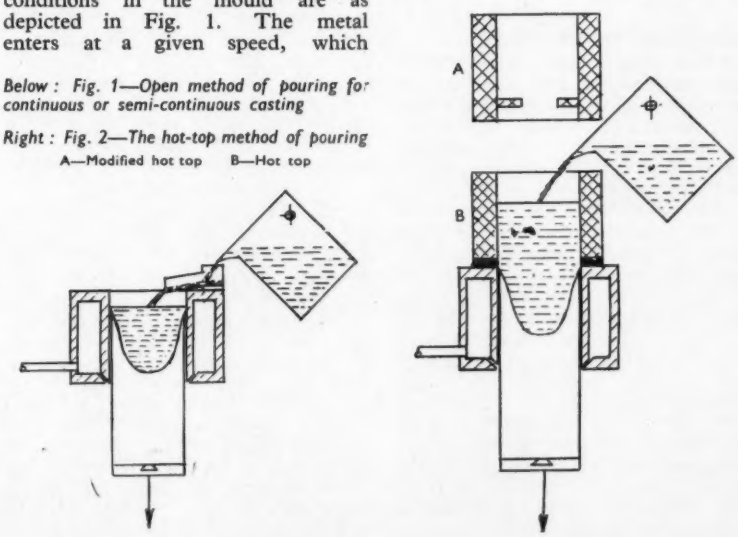
The development in semi-continuous casting described here appears to deal effectively with the casting problems created by the ingot size as well as by the alloy dross.

Metallurgical Considerations

When a molten metal is poured into an open-ended conventional semi-continuous casting mould, then the conditions in the mould are as depicted in Fig. 1. The metal enters at a given speed, which is just sufficient to keep the level of molten metal in the mould constant as the casting process continues. With small ingot cross-section sizes, the amount of metal required for a given time is so small that it becomes mechanically impossible to control the rate of pouring sufficiently accurately without resorting to complex devices which create new problems in their own way. At the same time, the impingement of the pouring stream on the molten metal in the mould unavoidably creates some dross, with the consequences on the ingot surface already described. In principle, both these problems can be solved by modifying the mould design, as shown in Fig 2 (B). In this case, described as the hot top method of pouring,[1] a conventional water-cooled mould is used for the main purpose of cooling the ingot. The top of the mould carries, however, a thin insulating disc, which supports an exothermic sleeve of the same type and design as used at present in normal sand foundry practice. The metal is poured into the exothermic sleeve in the usual way. However, owing to the high temperature maintained in this sleeve during the casting process, no solidification takes place in the sleeve. The first solid ingot skin forms in the water-cooled mould proper, and then the ingot is subsequently cooled in the conventional manner. It is evident from the cooling process described that the pouring speed and dross formation problem are thus largely resolved. The pouring can be now either interrupted or varied, as the level of the metal in the sleeve is of little consequence to the success of

Below : Fig. 1—Open method of pouring for continuous or semi-continuous casting

Right : Fig. 2—The hot-top method of pouring



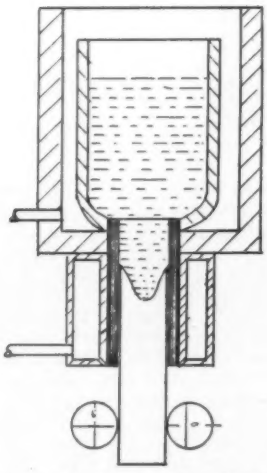


Fig. 3—The closed method (Asarco) of pouring for continuous or semi-continuous casting

the process. Similarly, the dross formed stays floating in the sleeve and eventually remains in the top of the ingot. Further improvement in the surface quality can be obtained by the application of a modified sleeve design, as shown in Fig. 2 (A). In this case a cleaning flux separates the solidifying from the poured metal, forming a further safeguard against possible dross inclusions.

Working Characteristics

As seen from Fig. 2, the hot top pouring method, in a way, combines some features of the conventional open method of pouring, so-called open systems, and the Asarco or closed pouring system (Fig. 3). The mould design, lubrication and cooling are similar to those used in open systems, and the open hot top replaces the holding furnace of closed systems. The hot top system can be readily built on to the conventional open systems casting unit without major alterations in design of the mould or the casting unit.

Light Alloy Applications

At the present time, the bulk of aluminium-base alloys cast in the form of ingots for subsequent working are produced by either semi-continuous or continuous casting methods of the vertical open type, using conventional short water-cooled moulds. The metal is poured from the furnace or a ladle normally via a launder into the mould, the rate of pouring being controlled by the degree of tilt of the furnace or ladle. Sometimes, when applying multiple pouring systems, the rate of pouring is controlled by means of mushroom-type valves. Neither of these pouring methods could be applied readily for small cross-section ingots, and one of the applications of the hot top pouring method may possibly be to cover this range of ingot casting. This is particularly likely in such plants where conventional casting machines are already available, as an alternative to using several types of machines to cover all the range of cast ingot sizes.

With the larger size light alloy ingots there are three metallurgical problems which are still frequently met when using the conventional semi-continuous or continuous casting process. These concern the surface quality, microstructure and sensitivity to cracking. It is of interest to examine these three phenomena in relation to the hot top method of pouring.

Ingot surface defects of light alloy ingots are largely of two types: surface dross and exudations. Both of these phenomena are partly influenced by the pouring technique. With the conventional pouring method, the dross created on pouring tends to flow towards the mould walls, where it remains hanging, subsequently thickens, and eventually is torn off and carried by the solidified ingot skin. In the hot top pouring method, the dross, largely aluminium oxide, remains floating in the feeder, and only clean metal passes into the water-cooled mould. Consequently, greatly improved ingot surface quality is obtained by the hot top process. It is customary at present to machine ingot surfaces to various depths prior to the subsequent working process, particularly in ingot rolling practice. Large quantities of swarf produced in this manner have small economic value. Thus, it appears that a reduction in the machining of cast ingot surfaces may prove a sufficiently strong economic factor for the application of the hot top process for larger size ingots.

Surface exudations are controlled by both alloy composition and the solidification conditions. In the hot top process, the magnitude of temperature gradients can be considerably lowered, resulting in reduced surface exudations. Insufficient experimental work has been carried out so far to state whether exudations could be completely eliminated. It is clear, however, that the hot top process at least promises some possibilities in this direction. The problem of exudation has so far defied a practical solution by the conventional open semi-continuous casting process, so that further work on the solution of this old metallurgical headache appears to be well justified.

Cast microstructures of light alloys, i.e. the size and shape of crystal grains, are of considerable practical importance, particularly for forged components. Similarly, the size and distribution of secondary phases within the individual grains have an effect on the subsequent behaviour of ingots, and thus have practical implications. Both of these phenomena are at present controlled by either alloy composition, chiefly by special additions of so-called grain refining elements, or by the rate of cooling. However, one casting variable has considerable effect upon both of these phenomena, and that is the pouring temperature. In the conventional semi-continuous casting process, the pouring temperature has to be considerably higher than the melting temperature, a fact which is conducive to coarser grains as well as coarser microconstituents. With the hot top system of pouring, the low pouring temperatures are, at the same time, beneficial from the point of view of reducing the gas content of molten metals.

Within recent years considerable research has been carried out on the subject of refining the macro- and microstructures by vibrations of various frequencies, from relatively large ones to ultrasonic varieties. With a liquid metal reservoir above the solidifying metal it would be comparatively easy to make use of such vibrations for practical applications. This is a possible field for future developments.

Internal stresses are generated in semi-continuous ingots, mainly as a result of intense temperature gradients produced by quenching ingots below the short water-cooled mould. These stresses lead sometimes to ingot cracking, which is a serious problem with a number of alloys of the "strong" variety. In current ingot casting practice, one of the frequent methods of minimizing such stresses is that of reducing the casting speed. However, a limit is reached for the application of this principle when cast ingots begin to show the formation of cold shuts. The possibility of having a molten metal reservoir above the mould should give further chance of reducing the casting speed with crack-sensitive alloys.

Copper-Base Alloys

Unlike light alloys, copper-base alloys have such variations in their casting characteristics that, for the purpose of a general review, it is more convenient to discuss these alloys in specific groups.

(a) *Pure copper.* Relatively small quantities of copper are at present semi-continuously or continuously cast. Various types of batch water-cooled moulds appear to cover most of the quality, as well as economic requirements. Probably the main field of interest of the hot top process lies in the range of small ingot cross-sections. Larger sections could be cast in pure copper by the normal open method of pouring, as pure copper is not subject to any of the problems encountered and discussed with light alloys. Considering the fact that pure copper is more readily continuously cast than any of its alloys, comparatively little interest in the field of continuous casting by the copper industry is, at first sight, difficult to explain. The reasons are likely to be found in the economic factors involved; it is not easy to pinpoint the major ones amongst these without detailed information about manufacturing costs.

(b) *Tin- and phosphor-bronzes.* Unlike all the alloys so far discussed. tin- and

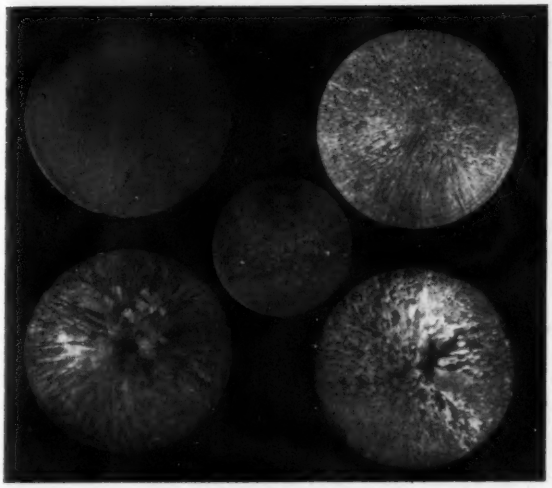


Fig. 4—Microstructures of semi-continuous cast bar. Top left, Manganese brass; top right, 70-30 brass; centre, aluminium bronze; bottom left, 60-40 brass (batch mould); bottom right, 60-40 brass (hot top)

phosphor-bronzes are unique in that some of them are, strictly speaking, mainly wrought alloys (e.g. coinage bronze) whilst others are essentially casting alloys (e.g. phosphor bronze). When the latter alloy is cast in the form of ingots, this is mainly for the manufacture of bearings so that, subsequent to casting, only a machining process completes the production and no subsequent deformation process is involved. By far the largest quantity of bearing bronzes are cast in smaller sections where the consumption demands are greatest. Tin bronze ingots for rolling are also cast on the smaller side, owing to the great metallurgical difficulties in rolling this alloy. It is thus clear why the bronze group of alloys are at present continuously cast by a process rather different from that normally used for light alloys. The Asarco method, employed here, makes use of a graphite mould built in the base of a relatively large holding crucible or furnace, so that no pouring problem into the mould arises.

Two features of the Asarco process are of interest when comparing it with the other processes. First, the graphite mould is consumable, the life varying from several to approximately 24 hr. Second, and following directly from the first factor, the process is mainly used as a continuous process rather than semi-continuous, using these terms in the commonly-accepted meaning. It thus appears of interest to develop a process which eliminates the pouring problem on the one hand, whilst retaining the copper water-cooled mould on the other. In this case, the problem of frequent mould replacements would not arise, and at the same time the process could be used intermittently or continuously as desired by the melting capacity and other production conditions. The hot top method of semi-continuous casting meets these requirements, and it will be of some interest to see whether this method will become established industrially for casting bearing bronzes. From the purely metallurgical quality aspect there is little to be found advantageous amongst the various semi-continuous and continuous casting methods for the bronzes, so that the choice amongst them will depend mainly on economic and production considerations. The hot top method, which is still in its early days of development, offers some useful possibilities which would justify industrial trials.

Brasses and nickel silvers. The brass group still represents one of the important groups of copper-base alloys, although the industrial importance of these alloys is not now what it used to be. These alloys are essentially of the wrought type, and the size of ingots cast is mainly determined by the capacity of the available rolling or extrusion plant. Ingot casting practice in these alloys is mainly governed by the behaviour of zinc as the chief alloying constituent, and its tendency to volatilize and oxidize at the normal melting and casting temperatures used. The conventional open method of pouring in semi-continuous casting is, therefore, difficult to apply for brasses, the difficulties increasing with the decreasing ingot size. As with the batch ingot casting methods, the main problem is that of obtaining good as-cast surfaces, i.e. keeping the zinc oxide dross essentially at the top of cast ingots.

In principle, both Asarco and the hot top method of semi-continuous casting could be applied for brasses. The relatively short life of graphite moulds, and the associated metallurgical difficulties, as well as the necessity for continuous melting, may well have been the main reasons for the current lack of interest of brass ingot producers in the graphite mould.

The hot top method was experimentally tried, using a Turner-Roscoe machine, but under laboratory conditions. Some of the results for 70:30 60:40 and manganese brass are shown in Fig. 4, the ingots varying from 1·75 to 2·75 in. dia. From the general principle of the hot top pouring method, it could be expected that the surface quality of ingots would be good. This was confirmed for all alloys used, with the best results obtained with manganese brass. The macrostructures obtained were governed mainly by the alloy composition, that of manganese brass being the finest. No specific work was carried out to make the other brasses fine-grained, as these alloys are usually hot worked satisfactorily and to the extent that the original cast size is not of great importance. This problem, however, may require further consideration in some special cases. Another aspect of the macrostructure in brass ingots which is of frequent practical importance is that of macroshrinkage. As seen from Fig. 4, semi-continuously cast ingots are perfectly sound in contrast to a normal batch type of ingot which frequently exhibits macroshrinkage cavities.

Aluminium bronzes. These alloys are well known for the difficulty of obtaining good cast ingot surface owing to the tenacious nature of aluminium oxide films which cover the molten alloy. The open method of pouring in semi-continuous casting has to be carried out with special precautions, to safeguard against a breakage of oxide films. This can be done reasonably well for large ingot sizes, but remains a formidable obstacle for small-size ingots. The hot top method offers here a distinct possibility, and the preliminary results obtained show that aluminium bronzes can be readily cast by this method.

Ferrous alloys. Grey iron and steel are rapidly entering into the field of semi-continuous and continuous casting. The hot top method described may be readily applied for grey iron bar stock, whilst in the case of steel it would largely depend on the development of suitable material for the insulating ring separating the mould and the hot top.

Future Prospects

The experimental work described shows that the hot top method of pouring has some useful features in comparison to the established pouring methods in semi-continuous casting of ingots. One good feature of this method is that it requires only small modification on an existing semi-continuous casting plant in order to carry out industrial trials. The possible applications of the hot top method will thus depend mainly on the outcome of such trials. Rolling slabs as well as extrusion billets could be cast by this method.

Acknowledgments

The authors wish to thank Professor Rollason, of the Industrial Metallurgy Department of Birmingham University for the provision of laboratory facilities, and Foundry Services Ltd. for the provision of exothermic sleeves.

Reference

[1] Brit. Pat. appl. 20149/57.

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Separation of Iron from Non-Ferrous Swarf

FOR the reclamation of non-ferrous swarf containing ferrous particles which must be separated before remelting, an improved dual drum separator has been introduced by Electromagnets Limited. Known as the "Boxmag"' super efficiency dual drum separator, this machine comprises two magnetic drums embodying "Alcomax" high efficiency permanent magnetic alloy units, so arranged that the ferrous contamination extracted from the non-ferrous material is retained on the drum shell until it rotates out of the non-ferrous feed, whence it is discharged into a separate container.

The drums are of a more efficient design than those previously manufactured, and their effectiveness is further improved by the new design vibratory feed trays, which are now actuated by rotary out-of-balance vibrator motors instead of the old type of cam and roller mechanism. This type of feeder provides a more consistent and steady feed of the swarf on to the drum, and helps in increasing the throughput of the machine.

The equipment is fed by a chain and bucket elevator into the primary feed hopper, which regulates the feed to the first feed tray by means of a rack and pinion operated regulation gate. The first drum removes the majority of the contamination, the slightly contaminated non-ferrous material passing forward to the second feed tray, which then feeds it upon a second drum, designed to search out any remaining ferrous contamination.

As an additional safeguard to ensure that any fine iron which may be attached to non-ferrous oily swarf is removed, a final permanent magnetic chute is fitted, over which all the non-ferrous material passes. The equipment has an output of approximately 2 tons/hr. of non-ferrous swarf.

Left: Separating ferrous material from non-ferrous scrap with the "Boxmag" dual drum separator

Thermic Boring Process in a Foundry

BREAKDOWN in a furnace can leave a solidified mass of metal that presents a difficult removal problem. This problem was recently encountered by Metallic Extractors Limited, of Water Orton, Warwickshire, who had to remove a solidified mass of raw copper. Weighing about 85 tons, the copper could only be used when broken up into small segments and removed.

Neither explosive charges nor normal breaking-up methods successfully yielded the right-sized pieces. The firm sought the advice of British Oxygen Gases Limited, and it was agreed that the thermic boring process should be used. A section of $\frac{3}{8}$ in. bore gas barrel steel tubing was packed with $\frac{1}{8}$ in. diameter mild steel rods. Oxygen was then fed through the rods at the high pressure of between 100 and 150 lb/in^2, and the end of the packed lance was then ignited. The iron and oxygen reaction provided the degree of heat which was required to melt the copper.

Due to the high thermal conductivity of the metal, a certain amount of heat was lost but the process was, nevertheless, found to be efficient and economical.

Batch Cleaning Tubes

THOROUGH cleaning, both inside and out, of over 150 tons weekly of non-ferrous tubing, much of it 14 to 20 ft. long, presented a major problem to Serck Tubes Ltd., of Birmingham. Previously they had used a chemical

Below: Using a packed lance for the oxygen cutting of a solidified furnace melt of copper

cleaner with several drawbacks, including inadequate degreasing, the subsequent formation of smut on the work, and contamination of other solutions in the cleaning, pickling and passivating line.

They now use Grisiron WZ, a product of Roto-Finish Ltd., at 50 gm/L. (8 oz/gal.), nearly boiling, for some 20 min. The 1,000 gal. of solution are maintained by additions whenever the rate of cleaning appears to be falling; this amounts to 5-6 cwt. of cleaning salts monthly, and every five or six weeks a new solution is made up. Another problem which has been ameliorated, although by no means eliminated, of course, is that of sludge. Grisiron forms a much lighter, more readily disposable sludge than its forerunner.

Automatic Photomicrography

CALLED the Ultraphot II, a Zeiss automatic camera-microscope, suited for visual observation and photography of microscopic and macroscopic specimens, has been installed at Padley and Venables Ltd., Sheffield. It combines microscope, camera exposure meter and illumination apparatus, and is suited for all kinds of research projects.

The optical and mechanical performance of the instrument fulfils exacting requirements. Both bright and dark field methods can be used; also phase contrast with trans-illumination or epi-illumination, using polarized or non-polarized light. The apparatus may also be used for microprojection on to ground glass plate.

Change-over from one technique to another is extremely simple since the various accessories can be rapidly mounted.

The photo-head of the camera can be used for taking photographs on plates and cut film. It embodies a photomicrographic camera provided with fully automatic exposure mechanism. As long as the microscopic image is in focus and the plate slide is pulled out, all that is necessary is to press a single push button to open the camera shutter. The exposure time is then adjusted automatically to the correct value, depending on the intensity of illumination and speed of film. When the picture is taken, the shutter closes itself.

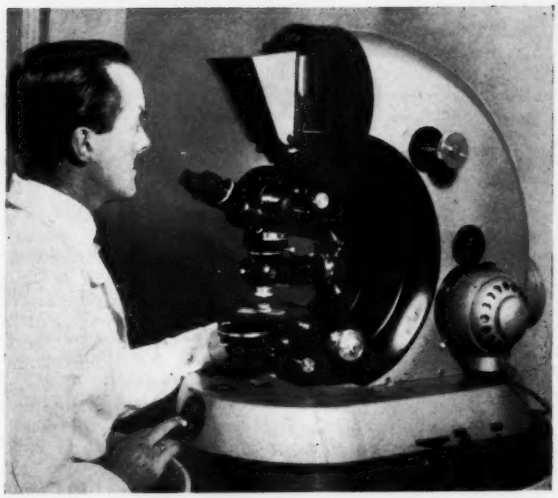
Production of Nitrogen for Industrial Processes

PRODUCING nitrogen by the combustion of any of the commercial fuel gases with air, the first two Holmes-Kemp nitrogen generators to be built in this country have recently been completed at W. C. Holmes and Co. Ltd., Turnbridge, Huddersfield. Operation can be almost entirely automatic, and the gas produced has a degree of purity which compares favourably with that of nitrogen made by any other full-scale production unit.

Controlled combustion is achieved by the use of a carburettor which is adjustable over a wide range to give varying fuel-to-air ratios, and which is automatically responsive to demand.

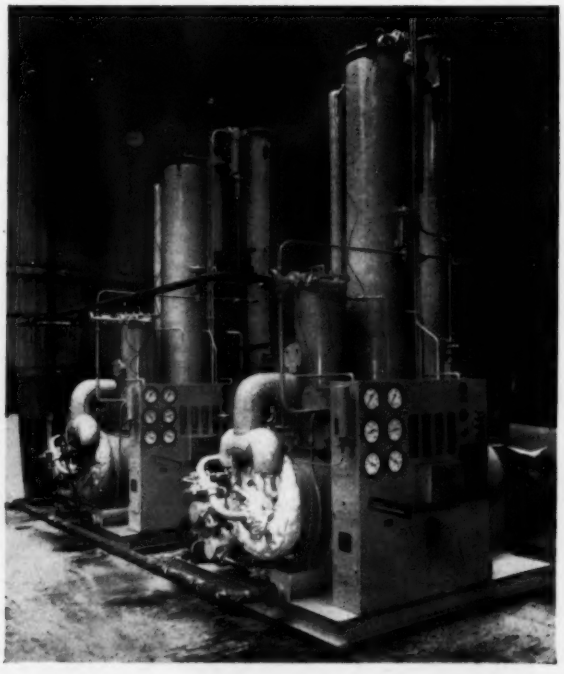
The products of combustion are cooled, and carbon dioxide removal is then carried out by passing the gas through an adsorber tower containing monoethanolamine. The plants are complete with re-boiler, stripper and heat exchanger for the regeneration of the monoethanolamine, thus providing a completely self-contained and a continuous system of operation.

A nitrogen compressor is usually provided to enable the gas to be stored at pressure. Where necessary, a Holmes-Kemp dryer can be included to ensure freedom from moisture. Plants of this type are available in capacities up to 20,000 ft^3/hr. nitrogen.

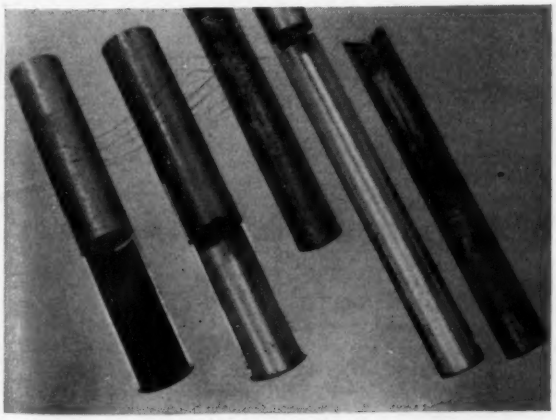


Combining microscope, camera and exposure meter in one unit, the Zeiss automatic camera microscope is operated by a single push button

Right: Nitrogen generators by W. C. Holmes and Co. Ltd.



Below: Centre sections of non-ferrous tube, $\frac{1}{2}$ in. to 1 in. diameter, before and after cleaning with Grisiron W.Z.



Research Progress

Coating Reactive Material

BY RECORDER

REACTIVE metals are usually coated to reduce or prevent serious attack of the metal by the service environment. There are several ways in which one metal can be coated with another, e.g. plating, spraying, sputtering, and so on, as well as the "mechanical" method of cladding during fabrication. These choices become more restricted, however, if one or both of the metals involved is exceptionally reactive or expensive, or if the purity of the coating and coated metals must be maintained at a high level. These features are often found when nuclear applications are being considered, and it is not surprising that the difficulties so arising have made necessary the development of unusual and advanced processing techniques.

A Paper[1] by R. E. Monroe, D. C. Martin and C. B. Voldrich, of the Battelle Memorial Institute, Ohio, describes a method of overcoming some of the problems associated with the coating of uranium with zirconium. Here, both the basis and coating materials are reactive and expensive, and it is clear that normal coating procedures, for example electroplating, are not likely to be applicable to this particular system. The use of metal spraying methods is made difficult by the ease with which deleterious impurities, such as oxygen and nitrogen, are introduced into zirconium near or above its melting point. Most of the available equipment for metal spraying employs gaseous media containing these elements for melting the coating metal, and so cannot be used here.

The Battelle workers considered three ways of avoiding this contamination. The first consisted of the arc-melting of two consumable zirconium electrodes, the molten product being directed on to the uranium by a high velocity stream of inert gas. The second was generally similar to the first but the arc was replaced by induction melting. In the third method, two discs of zirconium would be rotated at high speed, an arc struck between them and the molten material so produced flung off the discs by centrifugal forces on to the uranium. The engineering problems to be encountered with the third procedure seem likely to be considerable and, although the other two methods appear equally feasible, the availability of a commercial arc-spraying pistol led to concentration on the first of these.

Normally, the spraying gas used in the arc pistol mentioned above is compressed air which, for the present purpose, had to be replaced with an inert gas—argon or helium. It was quickly found that the stability of the arc was seriously affected by this substitution. Monroe *et al* attribute this to a lack of oxygen in the spraying gas, though it is presumably the difficulty of ionizing inert gas molecules which is the basic cause of such arc instability. Attempts to improve the performance of the pistol by impressing a high frequency voltage on the arc voltage were not successful because the insulation of the pistol would not withstand the desired conditions. It was thus necessary to construct equipment of greater flexibility, and the opportunity was taken to incorporate other features that would allow several operating variables to be controlled.

Among the factors that might be expected to influence the performance of the pistol are the momentum of the gas stream, the geometric arrangement of the electrodes and gas nozzle, the type and magnitude of the arc power, and the size and preparation of the wire electrodes. Most of these could be varied within wide limits in the apparatus constructed. Thus the electrodes were fed through drives, the position of which could be changed relative to one another and to the gas nozzle, the rate of electrode feed and the gas velocity could be preselected, and the electrical circuit was designed to accommodate a variety of power sources.

Initial tests were carried out with Type 304 stainless steel wire, $\frac{1}{16}$ in. thick, compressed air being used to provide the gas stream. It was found that reasonably stable arcs could be obtained with either alternating or direct current, but the former gave an erratic spray, probably due to arc re-ignition. A superimposed high frequency current improved the steadiness of the arc and the spray when direct current was being used. The authors stated that the best sprays were obtained with a current of 230 amp., an arc voltage of 37 V, a wire speed of 200 in/min., an included angle (between the two electrodes) of 25°, and the use of 70 lb/in^2 air through a 3 mm. dia. nozzle. "Coarser" sprays were said to be obtained at higher voltages, larger nozzle diameters and lower currents, wire speeds and gas pressures. It is not clear, however, whether the "coarseness" of the spray was due to uneven distribution or to a larger coating particle size.

After these apparently successful preliminaries, the authors turned to the spraying of zirconium and immediately found that " . . . Stability of the arc when using zirconium in an atmosphere of argon or helium was less than when using stainless steel in air." This, of course, was the very difficulty that the apparatus was designed to overcome. In a brief footnote, Monroe *et al* state that tests with aluminium, copper, Nichrome and Elgiloy in "various atmospheres" gave more stable arcs than zirconium. If this finding holds for inert gases, it suggests that the arc stability was being influenced by a property of the electrode metal, as well as by the use of inert atmospheres, and more details of these subsidiary experiments on other metals might have increased the general value of the Paper.

The conditions used to spray zirconium on to $1\frac{1}{2} \times 2$ in. specimens of $\frac{1}{4}$ in. thick uranium plate were: current 240 amp., voltage 35 V, wire feed 340 in/min., electrode angle $22\frac{1}{2}$°, gas pressure 85 lb/in^2, through a 4 mm. dia. nozzle. It may be assumed that these were the values giving the best coatings, though this is not stated categorically. The high wire speed is worthy of note, and gave rise to very small operating times (0·05 to 0·24 min.) for the thin coatings required. The layers of zirconium deposited showed defects, probably arising from the combination of high feed rate and arc instability. Large numbers of voids were present in association with relatively coarse, rounded particles of zirconium.

Attempts to improve the quality of the coatings by heat-treatment were made with some success. Air cooling after 17 hr. at 1,065°C. caused spalling of the coating, but generally similar treatments, followed by furnace cooling, gave an adherent layer in which interconnected porosity appeared to have been eliminated. Considerable diffusion had also occurred and in a photomicrograph shown, traces of the presence of uranium very close to the outer surface of the coating can be seen.

The primary objective of this Battelle work—to produce a uniform, dense coating of zirconium on uranium—was clearly not achieved. The failure can be attributed to the arc instability found with zirconium electrodes in an inert atmosphere, and it is interesting that the method was apparently found to be satisfactory when other metals were used. Recent advances in knowledge on the factors influencing zirconium-to-zirconium arcs (prompted by studies of consumable electrode melting) might provide the answer to this anomalous behaviour.

Reference

[1] R. E. Monroe, D. C. Martin and C. B. Voldrich; *Welding Journal*, 1958, **37**, (2), 114.

Reviews of the Month

NEW BOOKS AND THEIR AUTHORS

METAL WORKING

"ASME Handbook: Metals Engineering—Processes." *Published by McGraw Hill Publishing Co. Ltd., 95 Farringdon Street, London, E.C.4. Pp. xv+428. Price 104s. 6d.*

THE preparation of this book was undertaken by the American Society of Mechanical Engineers to fulfil the need for a ready reference for the design engineer, and while it will be of undoubted value to both the design engineer and to the engineering student, much of the information is of an elementary nature, although it is presented in a reasonably logical manner. The Board responsible for its preparation is comprised of representatives from the principal metal using industries and the technical press in the U.S.A.

There are nine principal parts, these being divided into a total of 42 sections, and it is unfortunate that there is little consistency in the consideration given to each of the many aspects of the engineering processes which the book purports to cover. Heat-treatment is dismissed briefly in a single section which comprises a complete part of the whole book, whereas the part dealing with cold working is comprised of no less than 12 sections and covers most forms of cold forming, but surprisingly excludes cold flow forging (impact extrusion). Few of the authors have included references to established works on their various subjects, and this is a considerable disadvantage to the more serious reader who requires more detailed and specific information on the subject in which he is interested, although Thielsch and Dawson on welding processes are an exception.

The quality of the sections varies considerably in their content: thus some can be regarded as a lengthy definition of the process involved, whereas others provide adequate technical and design data. The contributions by Appleton on thread and form rolling and Thielsch and Dawson on welding processes are most comprehensive, and the latters' contribution is worthy of consideration as a code of practice.

The title of "Welding and Cutting" is given to Part 6: this comprises seven sections, of which, however, only four deal with the subject of the title, the three remaining sections relating to furnace brazing, soldering and metallizing. Welding and cutting are dealt with very fully, the sections comprising no less than 132 pages out of a total of 428 for the whole book, compared with 96 pages devoted to cold working and only 22 pages to machining, the latter part, which excludes any reference to spark machining, relating to what is probably the most important of all engineering processes. Brazing, soldering and metallizing are covered in 32 pages and these sections should surely have constituted a part in their own right: in these sections reference is made solely to the furnace method of brazing, whereas brazing by other methods is widespread, particularly salt bath and induction processes. Aluminium brazing is dismissed as being conducted in air with no requirement of special atmospheres.

A further omission occurs in Naujoks' section on forging, in that commercial tolerances are referred to as being shown in a non-existent Fig. 16: section 8.1, dealing with cleaning of metals, also excludes reference to supersonic procedures for precision components, and the sodium hydride process for descaling.

While this publication will undoubtedly fulfil, in part, the need for general information in compact form of engineering processes, it cannot in any sense be regarded as a complete work of reference and it is to be hoped that any revision of the work undertaken by the Board will take into consideration the necessity for a better division of the subject matter and the need to achieve a similar standard of quality of the contents of the individual sections.

R. J. B.

ZIRCONIUM

"Zirconium." *Second Edition. By G. L. Miller. Published by Butterworth's Scientific Publications, 4-5 Bell Yard, London, W.C.2. Pp. xxi+548. Price 70s. 0d.*

A CAREFUL comparison between this second edition and the first, published only three years earlier, is likely to surprise even those who may consider themselves to be in close touch with the metallurgy of zirconium and the refractory metals. The progress, both in exact knowledge of the properties of the metal and in the technology of its production, has been amazingly rapid, and to keep pace with these rapid developments a considerable amount of re-writing has been undertaken by Dr. Miller. The new edition contains 548 pages and 168 tables, as compared with 382 pages and 122 tables in the first edition, and there are 99 additional figures.

Among the new matter, that of most general interest is probably the survey of arc melting practice with consumable electrodes. Dr Miller sets out very clearly the various techniques employed to maintain stable melting conditions in inert gas atmospheres and in various degrees of vacuum; and although he is careful not to adjudicate between rival claimants, one is left with the impression that he favours the school of vacuum melters. There is a useful discussion on alloy melting and a note on the possible causes of furnace explosions in arc furnaces. The chapters on mechanical properties of zirconium and zirconium alloys have been completely rewritten, and the two chapters originally devoted to structural and physical properties have been combined, re-arranged with some advantage, and extensively revised.

Dr. Miller explains in his introduction that the recent relaxation of "classified" information has made it possible to provide much more well-authenticated data than hitherto on many aspects of the metallurgy of zirconium. To quote one instance only, the methods used for separating hafnium from zirconium are now explained much more realistically, even though still rather sketchily.

All in all, this new edition is very much more than a reprint, and well worth acquiring to replace the first on any library shelf.

J. C. C.

PROCESS HEATING

"G.E.C. Process Heating Data." *Published by the Process Heating Department of the General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2. Pp. 144. Price 5s. 0d.*

INTENDED to provide a comprehensive range of data for the process heating engineer, this small book also contains, briefly, details of most of the main products of the G.E.C. in this particular field. These include such equipment as batch furnaces of various designs, roller hearth furnaces, conveyor ovens, salt baths, stoves for paint drying, welders, radiant heating equipment and much else.

The data and tabular matter represent a broad cross section of the information needed for day to day reference by the process heating industry. It covers, among other subjects, controlled atmospheres, properties of metals, coefficients of natural convection, conduit wiring capacities, weights of steel sheet etc., properties of solvents, notes on weldability, solders, specific heats, and various coefficients and conversion tables.

HYDRAULICS

"Trouble-Free Hydraulics." *By Ian McNeil. Published by Thames and Hudson Ltd., 30 Bloomsbury Street, London W.C.1. Pp. 124. Price 18s. 0d.*

IN the non-ferrous metals industry, as in almost all others, hydraulic mechanisms find a wide field of application, and engineers responsible for the maintenance of machines dependent for their operation on hydraulic fluids must often have wished

for a not too-technical book that would serve as a reference and manual. The volume under review sets out to provide the answer to a demand for such a work.

It is set out very broadly to cover the following questions. What maintenance is required to prevent machine breakdown and provide the best operating conditions? How and at what intervals should it be carried out? If a fault or breakdown arises in a hydraulic machine how can the cause of the trouble be traced and what remedy should be applied?

These problems are surveyed in a reasonably simple manner and for that reason the practical engineer on the shop floor will find the book a useful guide. Like all relatively non-technical works, however, it can only cover the major points as they occur in everyday practice. Similarly, it concerns itself largely with hydraulic systems in general; it does not delve into the specific problems associated with a variety of machine types.

It does, however, deal diagrammatically and textually with joints, bends, linkages, oil tanks, gland packings and seals of many types, and it discusses the choice and care of hydraulic oils at some length. Perhaps the most directly practical feature of the book is its last chapter "The Diagnosis and Cure of Faults."

Adherent Plating on Aluminium

A NEW method of obtaining electrodeposits on aluminium, which is claimed to give excellent adhesion, is reported by J. C. Withers and P. E. Ritt in *Metal Finishing*. This method consists of producing a thin coating of nickel on the surface of the aluminium, then heat-treating the nickel-clad aluminium, which forms a suitable base upon which any subsequent metal can be plated with perfect adhesion.

The aluminium is prepared and processed by the following operations:—(1) Degrease. (2) Etch. (3) Nickel strike 0·0001 in. to 0·0005 in. thick. (4) Heat-treat at a furnace temperature of 425° - 565°C. for approximately 5 min. The temperature depends on the aluminium alloy. (5) Clean. (6) Plate any desired metal.

The degreasing step removes oils and organic contamination on the surface of the aluminium. This may be accomplished by vapour degreasing or by soaking the aluminium in any solvent ordinarily used for this process.

The etching operation involves the use of two types of etches. The aluminium article is first etched in a 10 per cent by volume solution of hydrofluoric acid (48-52 per cent) for 10-15 sec. The article is then rinsed and transferred to a second etch of 50 per cent hydrochloric acid containing 9-10 gm/L. of manganous sulphate ($MnSO_4.H_2O$). The etching time varies from 10-80 sec., depending upon the aluminium alloy.

For the light alloys of aluminium, an etching time of 20-30 sec. is usually sufficient. For some die and sand castings, a more severe etch than hydrofluoric acid and water may be needed. In such cases, an etch which consists of three parts of nitric acid and one part of hydrofluoric acid may be substituted. After the aluminium article has been given the two etching treatments, it is dip rinsed and transferred to the nickel bath.

The nickel plate is obtained from a nickel bath of the following composition:—

Nickel sulphate ($NiSO_4.6H_2O$)	100 gm/L.
Magnesium sulphate ($MgSO_4.7H_2O$)	50 gm/L.
Ammonium chloride ..	10·5 gm/L.
Boric acid	10·5 gm/L.

The aluminium article is plated at 15 amp/ft² for approximately 10 min. to obtain the desired thickness of the nickel plate, which ranges from 0·0001 in. to 0·0005 in. thick.

It is presumed that during the heat-treating process some of the nickel diffuses into the aluminium and, because of the high surface energy of the nickel, readily agglomerates into islands.

The formation of the aluminium-nickel alloy and the formation of the islands provides a suitable surface upon which other metals may be electrodeposited. Metals plated on this surface have improved adhesion around the regions of the islands. However, if the heat-treatment is carried out in air, a thin layer of oxide is formed on the surface of the article. Before subsequent plating can be accomplished, the oxide must be removed by giving the article a reverse current treatment in 25 per cent sulphuric acid solution. If the nickel-plated aluminium is heat-treated in a non-oxidizing atmosphere, oxidation is minimized, and the article need only be dipped in a 25 per cent sulphuric acid solution for a few seconds to activate the surface before subsequent plating is carried out.

If the time in the hydrochloric acid etch is controlled very closely with each different type of alloy used, the heat-treatment step may be omitted, and fair adhesion of the nickel and aluminium will be obtained. It was found that with an aluminium alloy containing 4·5 per cent copper, 0·6 per cent manganese and 1·5 per cent magnesium (24ST) good adhesion could be obtained using an etch time of 18-22 sec. However, if the best adhesion is to be obtained in every case, and if the process is to be reproducible, the heat-treatment step is essential.

Ductile Bright Nickel

A DUCTILE bright nickel solution, available in two main types, "M.101" for use with mechanical cathode agitation, and "A.101" for use with air agitation, is now being marketed in this country by R. Cruickshank Ltd., under an agreement with the Hanson-Van Winkle-Munning Company of America and Dr. W. Kampschulte, of Germany. There is also a modified form for use in barrel plating.

The basic solution is a Watts type, to which is added P.B. No. 1 and S.B. No. 2 brighteners. When used with mechanical agitation, an anti-pitting agent, A.P.A. No. 3 is added.

The solution formula and operating conditions are as follows:—

Composition: Nickel sulphate ($NiSO_4.6H_2O$), 40 oz/gal.; sodium chloride (NaCl), 2·5 oz/gal.; boric acid (H_3BO_3), 6·5 oz/gal.; Brightener P.B. No. 1, 1-1·2 pints/100 gal.; Brightener S.B. No. 2, 1·25 oz/gal.; Anti-Pit Agent No. 3 (mechanically - agitated solutions), 1 lb/100 gal.

Operating conditions: Temperature, 110°-140°F. (130°F. optimum); cathode current density, 20-80 amp/ft² (40 amp/ft² optimum); anode current density, 10-20 amp/ft²; electrometric *p*H value, 3·5-4·5 (4·0 optimum); agitation, vertical or horizontal (mechanical) (12-25 ft/min.) or air agitation.

The brighteners, claimed to be entirely different from any others in use in this country, are easily added to the solution, the one being a liquid and the other a readily soluble powder.

The solution has a wide bright plating range and is said to possess excellent levelling properties, which ensure satisfactory results over a wide range of operating conditions.

The deposits have good ductility, combined with a high degree of levelling and brightness, and good receptivity to subsequent chromium plating.

Filtration of the solution may be carried out continuously through activated carbon, and this, together with the periodic addition of a small amount of hydrogen peroxide solution, maintains the condition of the solution over a long period, without the necessity of complete chemical purification.

Most bright nickel solutions in operation in this country to-day may be readily and economically converted and the suppliers will advise on the suitability for conversion of any existing solution.

Correspondence

Correspondence is invited on any subject considered to be of interest to the non-ferrous metal industry. The Editor accepts no responsibility either for statements made or opinions expressed by correspondents in these columns

Dr. C. H. Desch: An Appreciation — Scrap Exports

To the Editor of Metal Industry

SIR,—The brief announcement in your last issue of the death of Dr. C. H. Desch will have been read with sorrow by numbers of your readers, and many will wish to pay tribute to one who was an outstanding metallurgist and a very great teacher. His influence extended far beyond the Universities of Glasgow and Sheffield. His "Metallography," which was first published as long ago as 1910, provided many of us with our introduction to physical metallurgy and was treasured as an unfailing work of reference; and as edition followed edition it remained *the* standard text book on its subject. He was energetic, enthusiastic, and renowned for his encyclopaedic knowledge of the literature. My last memory of him was on a works visit at the post war Paris meeting of the Institute of Metals when, engaging the guide in eager passages in fluent French, he acted as interpreter to the party. With his passing we mourn one of the early leaders of our profession.

Yours etc.,
J. C. Chaston

Wembley,
Middx.

SIR,—May I draw your attention to the curiously inept manner in which the question of the export of manganese bronze scrap was handled—or should I say mishandled? It appears that the whole system of the granting of export licences is in urgent need of drastic revision.

Some time ago we were advised that export licences for manganese bronze had been granted, which seemed to indicate the removal of restrictions on this commodity. Like many other firms we sold it abroad, subject, naturally, to the granting of export licences. However, we were later informed that the Board of Trade had received numerous applications and that they intended to wait for a short time to ascertain the total number required, after which they would make a decision as to the number of export licences to be granted. In other words, a quota system was to be operated.

Now, after several weeks have passed, we have been informed that no further export licences are to be granted, presumably owing to the objections of the ingot-makers. It appears to be essential that in future, no licences *whatsoever* should be granted in similar cases, without previous consultation with ingot-makers, since their views constitute the deciding factor; and all parties interested in the matter should be allowed *equal* facilities for participation, if licences are granted.

Certain optimists express the opinion that owing to the alleged difficulty in treating scrap cable in this country at present, export licences should be granted; but I hope this will not occur at this juncture as in fact adequate facilities for treating cable do in fact exist and there is an insatiable demand at home on the part of consumers for copper and lead.

The joint Non-Ferrous Scrap Committee, whose members are drawn from various trade organizations representing the interests of metal merchants, which is the recognized authority, has been in communication with the Board of Trade on the subject of the liberalization of trading in non-ferrous scrap. It should impress on the authorities the necessity of granting licences according to the quota system intimated, so that those who have already applied may receive at least a proportion of what they applied for. I feel quite sure that our friends the ingot-makers would withdraw their objections to this procedure were they made aware that the prestige of the trade in this country suffers considerably if offers made abroad in good faith, cannot be honoured, and were firmly assured of full previous consultation in future.

The acute embarrassment we experienced is increased by the fact that the market has risen considerably since the offer was made and we are in the awkward position of having to explain to our friends abroad—after such a lapse of time—that we could not fulfil our proposed commitments.

It is true that we, and others who were holding stocks at the time have gained materially; but we feel that we have lost our friends' confidence and that respect which cannot be measured in terms of money.

If this does not effectively prove to those sincerely misguided protagonists who constantly aver that the respective interests of metal merchants and ingot makers do not conflict, I am indeed at a loss to know what will.

Yours etc.,
S. Sternberg

F. C. Larkinson Ltd.,
39 Hitchen Street,
Biggleswade, Beds.

Men and Metals

News from Copenhagen is to the effect that **Sir John Cockcroft** has been named as the 1958 winner of the Niels Bohr medal for special contributions towards peaceful uses of atomic energy. This medal is to be presented to Sir John in October next by **King Frederik** of Denmark.

Formerly with Garringtons Limited of Bromsgrove, **Mr. Michael Bottley,** has been appointed technical representative, specializing in automation sales and test rigs, to the Hymatic Engineering Company Limited, of Redditch.

At a board meeting of the company held recently **Mr. F. Foster,** M.Sc., A.M.I.E.E., was appointed managing director of Crompton Parkinson (Stud Welding) Limited, a recently formed subsidiary company of Crompton Parkinson Limited. After an earlier period of service with F. and A. Parkinson Limited, as a sales engineer, Mr. Foster joined the general sales department of Crompton Parkinson in 1937 becoming sales manager of the Plant section of the Overseas Division in 1948. In 1953 he was appointed general manager of the Cyc-Arc Stud Welding division. When the new subsidiary company was formed, in December last year, Mr. Foster was appointed a director and retained his responsibility as general manager.

It is learned from The Steel Company of Wales Limited that **Dr. Peter Roderick,** Ph.D., has been appointed assistant chief metallurgist of the Steel Division of the company. Dr. Roderick joined the company in 1955 and worked for a year as technical assistant in the operational research department before joining the metallurgical department as a research metallurgist. Later he became senior research metallurgist in charge of laboratories, a position which he held until his present appointment.

Various staff appointments have recently been made within the organization of Acheson Colloids Limited, a subsidiary of Acheson Industries (Europe) Limited, as follows:— **Mr. A. Cheney** has been promoted to sales manager and will operate from the new headquarters of the company at Plymouth. **Mr. G. J. B. Davies** has been appointed general manager of Acheson Dispersed Pigments Company at Dukinfield. **Mr. Edward A. Smith** has been promoted to the position of assistant manager, European Operations. **Mr. G. F. Henderson** has been promoted to assistant sales manager and will continue to operate from the company's Richmond office. **Mr. T. Wint** has been appointed sales engineer responsible for the North East territory and will operate from the company's Rochdale office.

Owing to ill-health it is understood that **Mr. N. Capsticks** is resigning his position as local director and commercial manager forgings of Thos. Firth and John Brown Limited. Mr. Capsticks has been with the company over 43 years.

INSTALLATION FOR HEAT-TREATMENT OF SPECIAL ALLOYS

High-Temperature Vacuum Furnace

MANY large parts made of metals such as stainless steel, zirconium and titanium are, for the first time, being brazed, heat-treated, annealed and stress relieved in an unusually large vacuum furnace which was recently installed at the Missile Development Division of North American Aviation Inc., Downey, California.

Built by Lindbergh Engineering Co., Chicago, it has the general configuration of a cylinder 40 ft. long and 78 in. inside diameter. It is being used to process materials and components for missiles, supersonic aircraft, and nuclear reactors.

Although it is generally referred to as a "vacuum furnace," one of its more important functions is to provide inert-gas atmospheres for metals requiring complete protection against oxidation at elevated temperatures. Compared with other furnaces which serve the same general purposes, it has the advantage of dimensions which permit the heating of such things as flat 4 ft. by 12 ft. sheets; it can be operated with precision at virtually all temperatures up to 2,150°F., and has provisions for the rapid cooling of materials without exposing them to contaminating gases.

The latter provisions are made possible by a series of 14 radiation baffles which are vertically mounted so as to establish two zones for alternate heating and cooling within the furnace. Water cooling facilities in the secondary zone are said to be capable of reducing the temperatures of heated materials at the rate of about 12°F/min.

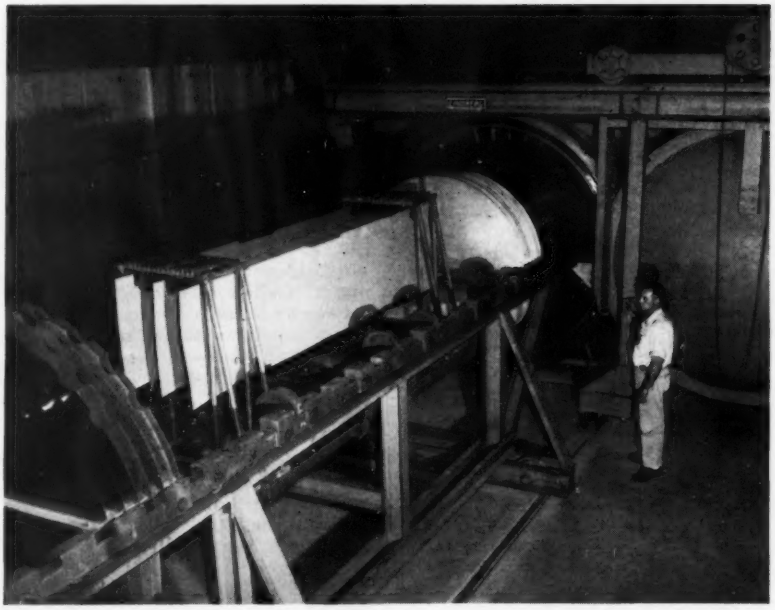
Three large transformers provide power for the Lindbergh rod-type elements, the consumption being 820 kW. Resultant heat is concentrated in a 12,000-lb. Inconel retort by means of the baffles and a 14 in. thick layer of fire and insulating brick, which separates the retort and the furnace's mild steel outer shell.

The vacuum system for the furnace includes three roughing pumps, two 16 in. ring jet diffusion pumps, and a small holding pump. It can reduce pressure in a 1,400 ft³ work area to 0·3 micron in only 25 min.

Parts are conveyed into the furnace's heating and cooling zones in batches weighing up to 1,000 lb. on an Inconel caterpillar-type conveyor cart. Appropriate gearing and vacuum seal bearings permit operation of the cart with an external electric motor.

A groove and ¼ in. O-ring make it possible to seal the furnace's sliding door with a chain and Acme thread mechanism.

When parts must be protected with an inert gas atmosphere, the furnace is initially evacuated so that argon or helium from an external pressure vessel can be admitted via a standard high-pressure valve.



Furnace for high-temperature operations under vacuum or inert gases, showing the radiation baffles on the conveyor cart entering the furnace

In order to determine the feasibility of the new furnace without risking too much capital, laboratory and pilot heating facilities were developed first. Both of these protoypes are still in operation, and the pilot installation is said to have paid for the present production unit by making it possible to salvage titanium sheet worth about $2¼ million.

Even greater economic advantages should be gained with the new furnace because of its comparative versatility. For example, it can be used to eliminate the instability of welded titanium parts, because its size will allow the components to be jigged against warpage before they are heated above their ageing temperature.

Heat-treatment and annealing applications account for most of the furnace's operating time at present. But, due to the growing need for brazed honeycomb structures in aircraft, this may be a temporary situation.

The new facility is said to be ideal for high-temperature brazing because of its ability to heat and cool oxidizable materials in protective atmospheres.

Light Metal Standards

SPECIFICATIONS and methods of test for light metals and alloys are contained in a recent issue of A.S.T.M. standards that supersedes the December, 1955, edition. It includes not only those specifications and methods of test which come under the jurisdiction of Committee B-7 on Light Metals and Alloys, but also those for light metal alloy die-castings, and those for aluminium wire and cable for electrical purposes, sponsored by Committee B-1 on Wires for Electrical Conductors.

Among the general topics covered are: ingots; castings; bars, rods, wire, shapes; forgings; pipes, tubes; sheet, plate; wrought products, filler metal; and electroplating. There are 51 standards, of which 36 are new, revised or have had their status recently changed.

Copies of this book may be obtained from A.S.T.M., 1916 Race Street, Phila. 3, Pa., at $3·75 each.

Obituary

Mr. M. Freedman

WE regret to record the death of Mr. Maurice Freedman, founder and managing director of M. Freeman and Co. Ltd., scrap merchants, of Brighton. The firm was established over 40 years ago, and Mr. Freedman was widely known in trade circles, having been a founder member of the London and Southern Scrap Iron and Non-Ferrous Metal Merchants Association, and director of Nafedscrap Ltd.

Industrial News *Home and Overseas*

Expansion in Wales

One of the relatively few remaining family businesses and the only heavy engineering fabrication plant in South Wales, **Sheppard & Sons Limited** of Bridgend, Glamorgan, opened a new erection shop and extension to their present factory last week. The new shop permits much larger fabrications for heavy engineering contracts to be undertaken and it constitutes the first of five stages in the company's expansion programme. Among the work in hand at present is a 40 ton electric arc furnace of Tagliaferri design being built to the order of G. W. B. Furnaces Limited and destined for Canada. A number of contracts are on hand for atomic energy work and for rocket research, one of which is a 40 ft. flame deflector for British Oxygen Wimpey Limited.

Several ingot casting machines including a single strand 120 mould zinc alloy ingot machine and a double strand 120 mould machine are being erected. These Sheppard ingot casting machines have been developed with a special booster drive to produce zinc alloy ingots free from ripple and surface imperfections, and several have been sold to America. The first of this type of machine to be installed in Europe has an output of 20 tons/hr. and was supplied last year to Vielle Montagne in Belgium. Interest in these machines is growing in Great Britain and a contract for this country is expected to materialize shortly.

Another contract of interest recently obtained by this company is for a pig casting machine for a Kaiserslautern (Germany) firm. This contract was obtained against direct German competition. While negotiating this contract Sheppard's managing director was able to interest the German company in the production of aluminium tube for agricultural purposes. The Spokane machine for producing welded aluminium tube is built by Sheppards for Reynolds T. I. Aluminium Limited, and licence arrangements are being discussed between the Kaiserslautern firm and Reynolds T. I. Aluminium Limited.

Bright Nickel Plating

As from Tuesday last (July 1) **Albright and Wilson (Mfg.) Ltd.** are marketing a new process for bright nickel plating. This process was originally developed in the United States by the Hanson-Van Winkle-Munning Co., where it is known as Nickel-Lume, and Levelume. Albright and Wilson have applied for registration of the name "Plusbrite," for the new process.

We understand that this process is completely new to the United Kingdom. It is said to combine with a fully bright finish better physical properties of the plate than have hitherto been available in this country. It offers considerable markets in the motor vehicle industry, for example, for the plating of a whole range of accessories such as bumpers and over-riders requiring a high standard of brightness and serviceability. It is also said that the process should find many uses in the plating of electrical appliances, steel pressings, forgings and zinc-based die castings, as well as brass and copper parts.

With the addition of this nickel brightener to their range of metal finishing treatments now available the company has further emphasized their interest in this field. From the sale of chemicals for steel pickling and rust-proofing processes, its interests have moved over recent years towards decorative finishing, (the Phosbrite range being an example of the development of polishing solutions for aluminium and copper alloys). During the last two years it will be recalled that the company has also been responsible for the U.K. development of the Kanigen process of chemical nickel plating for ferrous and non-ferrous metals, and plastics.

An Order from U.S.A.

Recent news from **Wild-Barfield Electric Furnaces Ltd.** is to the effect that they have recently received from the United States an order for twenty-eight 750 lb. capacity frequency induction heated aluminium holding furnaces valued at nearly $300,000. This order was secured in the face of severe competition from American furnace manufacturers.

Aluminium Derrick

A folding aluminium alloy derrick is one of the features of a mechanical jet drill mounted on a Land-Rover, which has been designed and manufactured in this country for use in mineral prospecting by French geologists in West Africa. The rig is used to position a mechanical hammer that drives tubing into the ground in order to obtain sub-surface samples, which are forced up and out of the tube under pressure from a water-jet.

In order to carry the derrick, drive mechanism, winch and pumping equipment, and also a 60-gallon water tank, the vehicle was specifically modified to increase its payload by welding stiffeners on the underside of the chassis and fitting supplementary rubber springs to those at the rear. With a load over the normal maximum, weight saving wherever possible was of prime importance and so the use of aluminium alloy for the derrick was considered essential; using Noral B51SWP —an alloy with a high strength/weight ratio, supplied by **Northern Aluminium Company, Ltd.** who also assisted with the design of the structure—the weight was only 80 lb. This showed a saving of 60 lb. compared with an equivalent tubular steel derrick, and kept the total load on the chassis just below the maximum allowable.

The derrick, which is 14 ft. high when extended, is constructed of $1\frac{1}{2}$ in. by $\frac{3}{16}$ in. angle. Reinforced at certain points with 6 s.w.g. sheet, also of Noral B51SWP, it is fastened with anodized alloy bolts secured with self-locking nuts. It is bolted to the chassis through a baseplate at six points where the tops of the chassis members have been specially built up to ensure that the structure is firmly anchored. While the vehicle is travelling the upper portion of the derrick is folded over the cab and secured by an elastic rope to the spare-wheel mounting on the bonnet. An additional advantage gained by using aluminium is that the structure is used unpainted as the natural oxide coating on the metal protects it from all weathers and renders painting unnecessary.

A £1m. Contract

An order has recently been received by **Davy and United Engineering Company Ltd.** from the Northern Aluminium Company Ltd., for a new four-high breaking down and plate finishing mill plant for the latter company's works at Rogerstone.

The value of this order is said to be over £1m. and is part of a larger scheme of expansion to increase the rolling capacity of the Rogerstone works from 50,000 to 75,000 tons of aluminium strip and sheet annually. The main unit to be provided by Davy and United is a four-high rolling mill capable of breaking down slab ingots weighing up to 8 tons, for plate up to 138 in. wide by $\frac{1}{4}$ in. minimum thickness.

Insulated Meat Container

Much interest is at present being shown in the Bristol area in the insulated meat container manufactured by Drew Bros. (Frampton Cotterell) Ltd. The chief

An aluminium derrick folded over the cab of a Land-Rover

novelty in this container is the way the floor is formed out of studded **Birmabright** treadplate, which radiused at the sides with resultant elimination of the "blood trap" which has always been present when angle or wooden beading has had to be used along the joint between floor and side. The new floor is very easy to clean and of course is quite hygienic.

The sides of the container are made out of Birmabright BB.2½H spaced corrugated sheet, which is said to simplify construction by cutting out the need for extra stiffening members.

Aluminium Paste Factory

A new factory has been built by **English Metal Powder Company**, at Uxbridge, Middx., to meet the increased demand for their aluminium paste. The range of their product has been widened by the production of a new high gloss, high metal content paste, which is stated to give a special mirror-like paint film of increased specular reflectivity. It is understood that the new factory is already working at full pressure, seven days a week, to meet orders from all parts of the world.

Australian Metals

Mineral output in Australia continued at a high level throughout 1957, despite a fall in prices for important metals such as lead, zinc and copper. The Minister for National Development (Senator W. H. Spooner), said this when commenting on a review of the situation published by his Department. Mineral exports, excluding gold, in 1957, were slightly higher in value at A£69,600,000 than the previous year's total, he said. The most important mineral commodities exported had been lead (A£32,237,000), zinc (A£9,234,000), rutile (A£8,617,000), copper (A£7,130,000) and coal (A£3,232,000). Mineral imports, excluding gold, increased from A£66 million F.O.B. in 1956 to A£78 million F.O.B. last year, Senator Spooner said.

Senator Spooner said details associated with production of minerals in Australia included: lead-zinc production increased to 332,470 tons of lead (concentrates) and 291,538 tons of zinc (concentrates) from 299,485 and 278,082 tons respectively the previous year. However, it was doubtful if there would be any any further increase in 1958 as several small mines had shut down and Broken Hill had reduced the number of working shifts. Mine production of copper improved by 3,000 tons to 56,613 tons in 1957, and production was expected to rise still higher in 1958. Exports of blister copper totalled 19,079 tons. Tin concentrate production fell by about 140 tons to 1,938 tons in 1957. Annual consumption had increased by about 1,000 tons to 3,508 tons with the opening of the Port Kembla tinplate plant last year.

New Copper Mill

Recent news from the Philippines states that a new copper mill installed by the Philex Mining Corporation will begin production shortly. The mill with a daily capacity of 1,500 to 2,000 tons will handle ore mined from the corporation's Santo Tomas II property near Baguio City in Northern Luzon.

Cuban Nickel

Improved quality and the stimulus of competition will unquestionably launch nickel on a sharp upward growth curve according to a statement released by the Cuban American Nickel Company, a subsidiary of the Freeport Sulphur Company. Industry, declared the company, had until recently been forced to minimize the use of nickel because of chronically short supply, but today can proceed freely with the development of new applications. The company itself is doubling Cuba's output of nickel by building facilities at Moa Bay, Cuba, and Port Nickel, Louisiana, with a capacity of 50 million lb. annually.

Cyprus Exports

Mineral exports revenue of Cyprus during 1957 was down by more than £2 million on 1956 the official mining report reveals. A further drop of £2 million in value of 1958 exports is officially predicted. The declines are due to world copper price cuts officials say. The quantity of mineral exports last year was slightly higher than in the previous year at 1,236,358 tons against 1,203,924 tons. Export values, however, were £10,449,691 against £13,845,254.

Machine Tool Exhibition

From the Sydney Chamber of Commerce, Australia, comes notice of an exhibition which is to be held in Sydney in May of next year devoted exclusively to the display of machine tools and accessories used in the metal and woodworking industries. This will be the second exhibition held by the Chamber and the forthcoming event will be held in three halls having a total area of 126,000 sq. ft. All available space is reported to have already been allotted.

Exhibits will come from the major machine tool industries of 13 different countries and will include a range of Australian made machines. Most machines will be seen in operating conditions.

Nickel Refining

Shown in London last week was the latest in the **International Nickel Company's** series of sound, colour films which is entitled "Refining Nickel from the Sudbury Nickel Ores." The first film told how the nickel is mined, the second how it is milled and smelted, and this third film tells the story of how it is refined.

After a brief prologue, the nature of the Sudbury ore is explained and there is a quick résumé of the processes that led up to the production of the oxide sinter which is the nickel refiner's starting material. The principle of electrolytic refining is demonstrated and the preliminary processes of melting the sinter, cleaning the slag, and the casting of nickel anodes are shown. Then follows a much more detailed account of the theory of electrolytic refining, together with a description of the method used to purify the electrolyte and so prevent metals other than nickel depositing on the cathode. The actual process of electrolytic refining is then shown. The sequencies showing the purification of the electrolyte lead into a brief account of the electrolytic refining of cobalt. The recovery of the nickel from the special alloy containing precious metals, made during the smelting operation, is shown.

The Mond Carbonyl process of refining nickel is described, first by a laboratory demonstration of the nickel carbonyl reaction and then by sequencies that show the actual plant, together with animations to illustrate the way each unit operates. The pressure carbonyl process for the production of nickel powder is described in detail. Finally, the chemical treatment applied to the residue from the carbonyl refining is briefly illustrated to show how the copper, cobalt, and residual nickel contained therein are turned into useful chemical salts and oxides. This film is available on free loan from **The Mond Nickel Company Ltd.**

Maintenance Agreement

A twelve months' maintenance agreement has been introduced by **Roto-Finish Ltd.** whereby a trained service engineer will visit customers' factories once every four months to overhaul and maintain Roto-Finish equipment. This agreement will be available in the first instance for factories in the main industrial areas. It is planned to extend the service to the whole of the country in due course.

It is emphasized by the company that this service is not intended to replace but to supplement the comprehensive free service which is already provided for their customers.

Scientific Instrument Exhibits

A most comprehensive range of analytical instruments was shown at the recent Achema exhibition in Frankfurt by **Hilger and Watts Ltd.** Some of the items shown were for the research laboratory but most were for automatic production control in industry. It was this latter group of instruments that attracted most interest from the many foreign visitors who made many enquiries about the facilities offered by this lastest Hilger equipment.

A Packaging Centre

On Tuesday last a new packaging centre, the headquarters of the Institute of Packaging, was opened at 50 Poland Street, London, W.1. The purpose of this Centre is to serve the packaging industries with detailed information on new developments, both of materials and in design. It will provide a permanent meeting place for executives interested in packaging and will house a technical reference library and information bureau. Special displays will cover all aspects of the industry.

Trade with U.S.A.

A notice has been issued by the United States Bureau of Customs to the effect that, as from August 1 next, the marking regulations applicable to certain metal products will be strictly enforced. Section 304 of the United States Customs Regulations relates to marking; under subsection (a) (3) of this Section, the Secretary of the Treasury is authorized to exempt articles from the requirement that they be individually marked with the name of the country of origin if they are included in a list (the "J" list), issued by the Secretary, which includes:

"Metal bars, except concrete reinforcement bars; billets; blocks; blooms; ingots; pigs; plates; sheets, except galvanized sheets; shafting; slabs; and metal in similar forms.

"Pipes, iron or steel, and pipe fittings of cast or malleable iron."

It has apparently been the custom, at some United States ports, to interpret this list more widely than was intended, but as from August 1, the exemptions under the "J" list will be strictly applied. For instance, copper pipes and copper tubes will need to be marked unless, of course, they are exempted under another subsection of Section 304. Similarly aluminium sheets, coils, and rods will be exempted but aluminium circles as well as semi-manufactured aluminium articles will not; however, the manufacturer in the United States who uses such articles in the manufacture of a new or different article is

considered the ultimate purchaser of the imported articles and in the event such articles reach the ultimate purchasers under circumstances in which one of the other exceptions set forth in section 304 (a) (3) of the act, as amended, is applicable, an exception from individual marking will be applied. Tin ingots, copper sheets and copper strips are exempted but if they are imported in containers for delivery to the ultimate purchaser in such containers the marking of the name of the country of origin must appear legibly and conspicuously on the container.

Copies of the United States marking regulations may be obtained from Export Services Branch (Tariff Section), Lacon House, Theobalds Road, London, W.C.1.

News from Birmingham

In the metal-using industries in the Midland area there has been a slight falling off in the volume of trade, but a good deal of the buying is hand-to-mouth. This is not surprising having regard to the uncertainty of prices. Strong efforts are being made, particularly among small firms, to increase export business, but the position is complicated by the restrictions placed on the entry of British goods, and the fact that competition from overseas makers is much fiercer than it was a few years ago. Suppliers of motor components are very busy and the outlook is very encouraging. Sales of domestic hardware have dropped since the beginning of the year.

A shortage of business in heavy structural steel is blamed for the reduction in the number of shifts worked at one of the big local steelworks. About 100 unskilled workers have become redundant. Demands from the motor trade are maintained. There is active trade in steel sheets and iron castings for that industry. Some improvement has taken place in the building industry. The plate mills are busy supplying the needs of the shipbuilding industry, but new orders are more difficult to obtain. In the heavy engineering industries employment is maintained on a good scale.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 19,010 tons, comprising London 5,885; Liverpool 11,775; and Hull 1,350 tons. Copper stocks totalled 13,757 tons and comprised London 8,124; Liverpool 5,358; Birmingham 75; Manchester 50 and Swansea 150 tons.

Non-Ferrous Club

A very successful golf meeting, the second of its kind to be held by the Non-Ferrous Club, was held on Thursday of last week at Stratford upon Avon. In the morning a Stapleford Competition for the METAL INDUSTRY Cup was played, the winner being Mr. H. B. Hoskison. Runners up were Mr. J. R. Pettman and Mr. Jim Diamond. Lunch was taken at the Club house, and a greensome was played in the afternoon. The winning pair were Mr. H. Bailey and Mr. E. Lisle, with Mr. Blackford and Mr. J. W. Huddleston second, and Mr. E. Holden and Mr. C. Wharrad third.

One of the features of the day's play was the high scores obtained, several players scoring well above average points. In the evening, dinner was taken at the Welcombe Hotel, Stratford upon Avon. After dinner the prizes were presented, but the President, Mr. W. H. Demel, announced that the winner of the Stapleford Competition was unavoidably absent so that the cup could not be presented on that occasion, but would be presented at the luncheon in July. Following the presentation of the other prizes—tankards and sets of golf balls, the Chairman Mr. H. McGhee proposed that the first captain of the Non-Ferrous Club Golfing Society should be Mr. T. B. Taylor. A further proposition created Mr. R. Deutsch the Society's secretary.

At the dinner which followed the annual golf tournament held by the Non-Ferrous Club, Birmingham, the prizes were presented by the President of the Club, Mr. W. H. Demel, who is shown holding the "Metal Industry" challenge cup. With him is Mr. T. B. Taylor, the newly elected captain of the club

Tin Consumption

World tin consumption in 1958—excluding Soviet Union and China—may be about 137,000 tons, according to an estimate by Vivian, Younger and Bond, Limited, in their tin review for May-June. This figure—based on consumption over the first four months of the year—would compare with about 152,000 tons consumed in 1957.

The report says the 1958 quotas of the six participating producing countries (if the 40 per cent rate of restriction is continued into the fourth quarter) would amount to 92,000 tons. There would in addition be about 12,000 tons from smaller producers and an assumed 15,000 tons from the Soviet Union, making a total supply of 119,000 tons.

Despite the inclusion of the Russian supplies, this would indicate a deficit for the whole of 1958 amounting to 18,000 tons. But it did not include all the pipeline stocks to be worked off before the flow of tin lessened to the restricted rates. Estimates of the extent of this surplus might vary, but it must amount to at least 20,000 tons and its selling was almost inevitably concentrated into the first few months of control.

This factor had, so far, outweighed the calculated deficit of 1,500 tons a month and it explained why, despite restriction, there had been an overall excess of tin for sale up to the present—an excess, which in order to keep prices steady, the Buffer Stock had had to absorb.

By now, most of the surplus pipeline had doubtless been worked off, the report concluded, but only when it had almost disappeared would the market pressure be relieved. Much could turn on whether United States consumers were moved to step up their rate of buying after midsummer. Early in the year they were almost out of the market and if they decided to replenish their stocks later in the year the market should pick up.

Aluminium Stockpile Plan

News from Washington is to the effect that the United States Interior Committee has rejected by a seven to four vote a proposal to stockpile 150,000 short tons of primary aluminium. Senator Nueberger, who offered the proposal as an amendment to a long range price support programme for minerals, had suggested the Government purchase the aluminium at the market price with a maximum of 27 cents per lb.

After voting down the measure, the Committee continued to work in executive session on further details of its price support programme on lead, zinc, tungsten and fluorspar.

Copper Import Tariff

Latest news from the U.S.A. is that as from Tuesday last, July 1, a 1·7 cents per lb. tariff will be imposed on all primary copper imports into the U.S. This follows automatically from the fact that Congress has taken no step to further suspend the copper tariff which has been in suspension since May 22, 1951.

Originally four cents under the tariff act of 1930, the excise tax under the Geneva trade agreement was reduced to two cents a lb. in 1949.

The history of the copper tariff suspensions shows suspension in April, 1947, until March 31, 1949, and one expiration further suspended until June 30, 1950. The tax (two cents per lb) was reimposed on July 1, 1950, suspended again on May 22, 1951, retroactive to April 1, 1951, and until February 15, 1953, and again until June 30, 1955. Suspension was further extended to June 30, 1955, and again till June 30, 1958. With the import tax restored, the 1956 Geneva agreement provides for five per cent reduction effective on June 30, 1956, 1957 and 1958, provided the price is above 24 cents delivered Connecticut Valley. If the price is below 24 cents delivered Connecticut Valley the two cents tax would prevail.

Metal Market News

IT is perhaps significant that although the copper market last week had a number of bullish factors to help it the nett gains for the five days trading were quite small amounting to only 15s. for cash and £1 for 3 months. Trading was quite active but not so hectic as of late, the total, including Kerb dealings, falling short of 10,000 tons. At the best the three months price climbed up to £202 10s. 0d. but at the close on Friday afternoon cash stood at £198 15s. 0d. and three months at £199 10s. 0d. Fairly early in the week the custom smelters dropped their price to 25½ cents but this cut of 1 cent did not appear to worry the market unduly. Anaconda remained at 26½ cents but neither Kennecott nor Phelps Dodge made any move to draw level and some doubt has been expressed about Anaconda's ability to keep its quotation at this high level. There was a reduction of 725 tons in stocks of copper in L.M.E. warehouses to 14,157 tons, the lowest level seen for some time past but with the import duty coming on in the States there is certainly no encouragement to ship copper across the Atlantic. As we write it seems very likely that there will be a strike at the Braden mine at El Teniente and if its duration is anything like that at the Chuquicamata property then Europe is going to be deprived of quite a lot of copper. Under date of June 26 came also news from Chile that the Copper Department there will request the Government to seek revision of those international agreements which hinder the sale of Chilean copper on the world market.

The May copper statistics to which brief reference was made last week are shown in more detail below in short tons of 2,000 lb. Production of crude copper in the U.S.A. was 90,900 tons and of refined 116,000 tons while deliveries to consumer totalled 78,700 tons. Outside the United States, output of crude copper was 138,000 tons and of refined 109,300 tons while deliveries amounted to 134,100 tons. In the States, output of both grades was down and so were deliveries, but elsewhere there was an improvement on the April figures in the case of deliveries to the extent of 5,600 tons. In the U.S.A. the cuts that have been made in output are beginning to show up but in other parts of the world there does not seem to be much alteration. On this side of the Atlantic wirebars continue to command a premium of something like £10 to £12, for demand exceeds supply but there is no news of anybody going short. It is believed that some parcels of fire refined quality have been taken up from the market. The Braden property supplies blister and fire refined in cakes and ingots but not wirebars, so that the present sectional shortage of wirebars will not be made worse by strike action at the mine.

Dealing on the tin market was again quite active and for the week the total turnover was in the neighbourhood of 1,200 tons including business done on the Kerb. Little change was seen in value but the three months position advanced by £1 to £733. A good deal of interest was taken in the announcement by the Chairman of the Tin Council that an approach had been made to Russia with a view to their joining the Tin Scheme. In the meanwhile there has been quite a bit of buying on the market at the support level and it must be presumed that Russian tin is again being offered on the market. How the tin situation will develop eventually it is not easy to say. Both lead and zinc were a good deal encouraged by the prospect of stockpiling these metals in the United States and there is a good deal of optimism about the future of the respective values. There is not, as in the case of copper, any complication from a prospective change in the import duty and the market in London looks quite firm. After a turnover of some 4,500 tons, lead registered a gain of 30s. for June and of 32s. 6d. for September. In the case of zinc the improvement was more modest amounting to 17s. 6d. for June and 22s. 6d. for September. The turnover was 5,150 tons.

Paris

The demand for powdered nonferrous metals seems to be growing. The Carbone-Lorraine Company has just announced that for the first quarter of the year its sales of certain powdered metals, notably tungsten, has gone up by 27 per cent. 41 per cent was exported against only 36 per cent in 1956. The first quarter of the year saw a fall in copper imports from 45,671 tons for the same period in 1947 to 36,985 tons this year.

Nickel imports fell from 993 tons to 727 tons and lead from 4,080 tons to 1,211 tons. On the other hand the import of tin rose from 2,983 tons for the first quarter of last year to 4,578 tons and that of zinc from 4,471 tons to 5,135 tons.

The future of French industry is in the balance at the moment. As the foreign currency position is grave it was generally thought that a severe limitation would be put on all imports. This would have led to unemployment. The present Minister of Finance, M. Pinay has said he is against limitation and will not stop imports nor introduce rationing. what he intends doing to meet the position is not clear. It is unlikely that the new de Gaulle loan will bring out the dollars and the gold because too many people are not sure yet which way the political cat is going to jump. Indeed politically France cannot hope to be stable before the end of the year The industrial position therefore, will be affected unless France asks for another foreign loan and gets it.

New York

The speculative flurry in copper on the U.S. market abated last week and the basic demand/supply position in the metal reasserted itself. Both Kennecott and Phelps Dodge did not follow the 1½ cent copper price advance initiated by Anaconda and a leading customs smelter, dissatisfied with its sales, cut its price by one cent a pound to 25½ cents. Other custom smelters followed suit and the price became general at 25½ cents. However, one leading custom smelter source said that with the two leading producers at 25 cents, custom smelters might have to lower their price further.

Keen copper analysts wondered what would be the outcome of the current price confusion in copper. They held that a split producer price could hold perhaps for a few weeks but no longer. Either Anaconda would have to rescind the price cut or the other two would advance their price. Anaconda fabricating subsidiaries were pricing their copper products on a 25 cent primary copper basis because of the competitive situation.

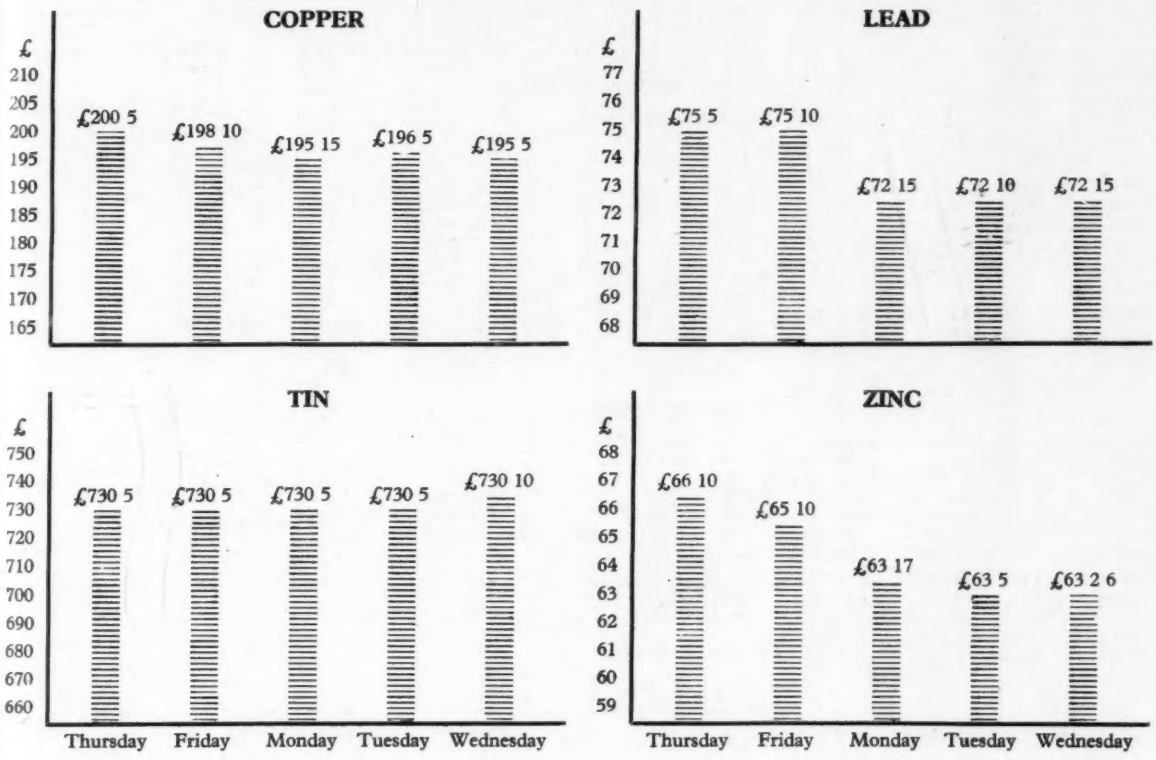
Brass mill officials reported that demand from their customers was "petering out." Most of them said a previous surge of buying was inventory build-up as a hedge against possibly higher copper prices and expected this would cut into July business that is normally slow because of summer vacations.

Lead and zinc sales quoted during the week, with some disappointment engendered in the trade by the failure of the Secretary of Interior to recommend a one-year stockpiling programme when he testified before the Senate Interior Committee. Instead he recommended government support prices on limited quantities of domestic lead and zinc to make more acceptable to Congress the previously announced Federal proposal aimed at stabilizing prices of lead, zinc, acid grade fluorspar and tungsten. However, the Senate Interior Committee was expected to include a one-year programme of lead and zinc stockpiling in the legislation it was drawing up and the latest word from Washington was that Secretary Seaton did not oppose the inclusion of lead and zinc stockpiling in the programme. In addition, the committee was expected to leave lead and zinc in the stabilization scheme and raise the proposed price support levels by one cent a lb. on the two metals.

Tin, after early firmness, softened as buying interest was lacking. Most traders believed that the U.S.S.R. would not join the International Tin Council. Consumer interest in tin was negligible.

METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 26 June 1958 to Wednesday 2 July 1958



OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≃ £/ton	Canada c/lb ≃ £/ton	France fr/kg ≃ £/ton	Italy lire/kg ≃ £/ton	Switzerland fr/kg ≃ £/ton	United States c/lb ≃ £/ton
Aluminium		22.50 185 17 6	210 182 15	375 217 10		26.10 208 17 6
Antimony 99.0			195 169 12 6	430 249 10		29.00 232 0
Cadmium			1,500 1,305 0			155.00 1,240 0
Copper						
Crude						
Wire bars 99.9				400 232 0		
Electrolytic	27.50 201 0	24.00 198 5	250 217 10		2.30 192 7 6	25.00 200 0
Lead		10.50 86 15	110 95 15	184 106 15	.93 77 15	11.50 92 0
Magnesium						
Nickel		71.50 590 10	1,205 1,048 7 6	1,300 754 0	7.80 652 5	74.00 592 0
Tin	103.00 753 0		911 792 10	1,400 812 0	8.60 719 2 6	95.00 760 0
Zinc						
Prime western		10.00 82 12 6				10.00 80 0
High grade 99.95		10.60 87 10 0				
High grade 99.99		11.00 90 5				
Thermic			107.12 93 2 6			
Electrolytic			115.12 100 2 6	161 93 7 6	.82 68 10	11.25 90 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 2/7/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	195	5	0
Fire Refined 99·70%	„	194	0	0
Fire Refined 99·50%	„	193	0	0
Copper Sulphate	„	70	0	0
Germanium	grm.		—	
Gold	oz.	12	10	5½
Indium	„		10	0
Iridium	„	22	0	0
Lanthanum	grm.		15	0
Lead English	ton	72	15	0
Magnesium Ingots	lb.		2	5½
Notched Bar	„		2	10½
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	76	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	25	0	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	3
Tellurium	lb.		15	0
Tin	ton	730	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	63	6	3
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	88	6	3
Granulated 99·99+%	„	101	1	3

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†**Aluminium Alloy (Secondary)**				
B.S. 1490 L.M.1	ton	150	10	0
B.S. 1490 L.M.2	„	157	10	0
B.S. 1490 L.M.4	„	177	10	0
B.S. 1490 L.M.6	„	192	10	0

†Average selling prices for May

***Aluminium Bronze**				
BSS 1400 AB.1	ton	200	0	0
BSS 1400 AB.2	„	213	0	0
***Brass**				
BSS 1400-B3 65/35	„	138	0	0
BSS 249	„	175	0	0
BSS 1400-B6 85/15	„		—	
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	167	0	0
(86/7/5/2)	„	177	0	0
(88/10/2/1)	„	225	0	0
(88/10/2/½)	„	236	0	0
Manganese Bronze				
BSS 1400 HTB1	„	170	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	250	0	0
Phosphor Copper				
10%	„	220	0	0
15%	„	227	0	0

**Average prices for the last week-end.*

Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	345	6	0
Grade D Plumbers	„	279	9	0
Grade M	„	378	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9	„		—	
Zinc Alloys				
Mazak III	ton	94	6	3
Mazak V	„	98	6	3
Kayem	„	104	6	3
Kayem II	„	110	6	3
Sodium-Zinc	lb.		2	5

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			£	s.	d.
Sheet 10	S.W.G.	lb.		2	8
Sheet 18	S.W.G.	„		2	10
Sheet 24	S.W.G.	„		3	1
Strip 10	S.W.G.	„		2	8
Strip 18	S.W.G.	„		2	9
Strip 24	S.W.G.	„		2	10½
Circles 22	S.W.G.	„		3	2
Circles 18	S.W.G.	„		3	1
Circles 12	S.W.G.	„		3	0
Plate as rolled		„		2	7½
Sections		„		3	1½
Wire 10	S.W.G.	„		2	11
Tubes 1 in. o.d. 16	S.W.G.	„		4	0

Aluminium Alloys			£	s.	d.
BS1470. HS10W.		lb.			
Sheet 10	S.W.G.	„		3	0½
Sheet 18	S.W.G.	„		3	3
Sheet 24	S.W.G.	„		3	10½
Strip 10	S.W.G.	„		3	0½
Strip 18	S.W.G.	„		3	2
Strip 24	S.W.G.	„		3	10
BS1477 HP30M. Plate as rolled		„		2	10½
BS1470. HC15WP.					
Sheet 10	S.W.G.	lb.		3	6½
Sheet 18	S.W.G.	„		4	0½
Sheet 24	S.W.G.	„		4	10½
Strip 10	S.W.G.	„		3	9½
Strip 18	S.W.G.	„		4	0½
Strip 24	S.W.G.	„		4	8
BS1477. HPC15WP. Plate heat treated		„		3	5½
BS1475. HG10W. Wire 10	S.W.G.	„		3	9½
BS1471. HT10WP. Tubes 1 in. o.d. 16 S.W.G.		„		4	11
BS1476. HE10WP. Sections		„		3	1
Beryllium Copper					
Strip		„	1	4	11
Rod		„	1	1	6
Wire		„	1	4	9
Brass Tubes		„		1	6⅞
Brazed Tubes		„		—	
Drawn Strip Sections		„		—	
Sheet		ton		—	
Strip		„	222	15	0
Extruded Bar		lb.		1	9½
Extruded Bar (Pure Metal Basis)		„		—	
Condenser Plate (Yellow Metal)		ton	160	0	0
Condenser Plate (Naval Brass)		„	171	0	0
Wire		lb.		2	4½
Copper Tubes		lb.		1	11½
Sheet		ton	223	15	0
Strip		„	223	15	0
Plain Plates		„		—	
Locomotive Rods		„		—	
H.C. Wire		„	248	15	0
Cupro Nickel Tubes 70/30		lb.		3	3⅞
Lead Pipes (London)		ton	115	0	0
Sheets (London)		„	112	15	0
Tellurium Lead		„	£6 extra		
Nickel Silver Sheet and Strip 7%		„		3	3½
Wire 10%		„		3	10½
Phosphor Bronze Wire		„		3	8½
Titanium (10,000 lb. lots) Billet 11″-4″		lb.	69/-		60/-
Wire ·315″-·036″		„	101/-		201/-
Sheet (4′/8′×2′) ·160″-·010″		„	100/-		158/-
Strip ·048″-·003″		„	100/-		350/-
Tube Representative gauge		„	320/-		
Extrusions		„	137/-		
Zinc Sheets, English destinations		ton	97	5	0
Strip		„	nom.		

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 1/7/58.

	£
Aluminium	
New Cuttings	135
Old Rolled	110
Segregated Turnings	90
Brass	
Cuttings	119
Rod Ends	117
Heavy Yellow	102
Light	97
Rolled	112
Collected Scrap	100
Turnings	110
Copper	
Wire	165
Firebox, cut up	165
Heavy	158
Light	153
Cuttings	165
Turnings	150
Braziery	130
Gunmetal	
Gear Wheels	160
Admiralty	160
Commercial	134
Turnings	129
Lead	
Scrap	66
Nickel	
Cuttings	—
Anodes	440
Phosphor Bronze	
Scrap	134
Turnings	135
Zinc	
Remelted	56
Cuttings	43
Old Zinc	32

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£174.0.0)	200
Heavy copper	(£169.12.6)	195
Light copper	(£147.0.0)	169
Heavy brass	(£108.15.0)	125
Light brass	(£82.12.6)	95
Soft lead scrap	(£62.12.6)	72
Zinc scrap	(£36.10.0)	42
Used aluminium unsorted	(£87.0.0)	100
France (francs per kilo):		
Copper	(£208.17.6)	240
Heavy copper	(£208.17.6)	240
Light brass	(£143.10.0)	165
Zinc castings	(£65.5.0)	75
Lead	(£82.12.6)	95
Tin	(£565.10.0)	650
Aluminium	(£117.10.0)	135
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£191.10.0)	330
Aluminium copper alloy	(£107.7.6)	185
Lead, soft, first quality	(£85.17.6)	148
Lead, battery plates	(£50.10.0)	87
Copper, first grade	(£188.10.0)	325
Copper, second grade	(£177.0.0)	305
Bronze, first quality machinery	(£188.10.0)	325
Bronze, commercial gunmetal	(£159.10.0)	275
Brass, heavy	(£130.10.0)	225
Brass, light	(£119.0.0)	205
Brass, bar turnings	(£127.12.6)	220
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

Financial News

LIGHT METALS STATISTICS IN JAPAN
(February, 1958)

Classification	Production	Shipment	Stock	Export
Alumina	10,983	11,123	14,125	0
Aluminium				
Primary	5,169	5,981	2,458	666
Secondary	1,783	1,755	331	0
Rolled Products	5,842	5,778	1,617	594
Electric Wire	1,010	1,233	1,407	233
Sheet Products	1,292	1,376	915	67
Castings	1,699	—	—	—
Die-Castings	900	—	—	—
Forgings	20	—	—	—
Powder	—	—	—	—
Primary Aluminium (March)	6,511	6,550	2,410	1,036
Sponge				
Titanium	134	141	849	141
Magnesium	63	71	1	20
Secondary	209	226	194	0

Wolverhampton Metal

The directors of The Wolverhampton Metal Company Ltd. are recommending payment of a final dividend of 17½ per cent (less tax). An interim of 10 per cent was paid in December last. Group trading profit is shown at £507,119 (£627,162) and Group profit after tax is £241,069 (£303,325). To general reserve £44,001, balance carried forward £519,854.

Johnson, Matthey and Co. Ltd.

Group net profits are shown at £934,492 after tax at £789,853. Final dividend of 7 per cent making 10 per cent for the year (same).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Winston Metals (Worcester) Limited (602321), 16a Tyebridge Street, Worcester. Registered April 8, 1958. Nominal capital, £500 in £1 shares. Directors: Barrie G. Winston and Mrs. Dinah Winston.

Hillgate Casting Company Limited (603396), 2 Portwood Place, Stockport, Ches. Registered April 24, 1958. To carry on the business formerly carried on as Hillgate Casting Company, and to carry on business of sheet metal workers, coppersmiths, engineers, etc. Nominal capital, £100 in £1 shares. Directors: Gordon Moreland and Florence Moreland.

Lucas and Seaby Limited (603404), 53 Northampton Street, Birmingham, 18. Registered April 24, 1958. To take over business of a metal worker carried on at Birmingham formerly by R. W. Seaby, deceased, as "L. Lucas," etc. Nominal capital, £5,000 in £1 shares. Directors: Hagar E. Seaby, Reginald E. Seaby and Dennis W. Seaby.

C. and L. Hill (Die Castings) Limited (603437). Registered April 25, 1958. To amalgamate and develop the businesses of manufacturers of moulds, dies and cutting tools carried on by W. H. Wheeldon and Co. at Manchester, and C. and L. Hill Ltd., at Willenhall, respectively, etc. Nominal capital, £50,000 in £1 shares. Directors: Alfred G. B. Owen, Carl A. B. Lindop, William A. Bannister, Leslie E. Morris, William H. Wheeldon and Frank Gleave.

Surplus Metal Polishing and Plating Co. Limited (603470), 84 Forest Road, Edmonton, N.9. Registered April 25, 1958. Nominal capital, £1,000 in 5s. shares. Directors: Cecil A. Ramsden and Gladys L. Ramsden.

Clarence Products (P.B.T.) Limited (604055), 120 Roding Lane North, Woodford Green, Essex. Registered May 6, 1958. To carry on business of electro, nickel, chromium and cadmium platers, bronzers, etc. Nominal capital, £100 in £1 shares. Directors: Sidney Baynes, Sydney G. Parker and Lewis M. Thomas.

Scientific Metal Company Limited (604307), 69 Gloucester Place, W.1. Registered May 9, 1958. Nominal capital, £1,000 in £1 shares. Director: Cyril D. Korn.

Parliamentary News

By Our Lobby Correspondent

The Minister of Labour, Mr. Iain Macleod, announced in the Commons that he hoped to make a new First-Aid in Factories Order before the end of the year.

He said that revised drafts of the First-Aid in Factories Order and of the first-aid leaflet had been sent to interested organizations in April, 1958, and their comments were invited by 30th June. Subject to their comments he hoped to make a new Order and to publish a new leaflet before the end of the year. His department had discussed the question of the recruitment and training of persons in first-aid in factories with representatives of the St. John Ambulance Association, St. Andrew's Ambulance Association and the British Red Cross Society. As a result it had been decided to select, in consultation with representatives of those associations, two or three places in each of the fourteen divisions of the Factory Inspectorate where special efforts would be made to stimulate an increase in the number of factory workers taking initial or refresher courses in first-aid. He attached great importance to the success of those efforts, as an increase in the number of factory workers with up-to-date training in first-aid treatment was essential in securing the improvements in the present situation which everyone agreed to be necessary. He was glad that the British Employers' Confederation, the Trades Union Congress and the nationalized industries had indicated their support for those proposals. Further action would depend on the results achieved in the places selected for those special efforts to stimulate training.

THE STOCK EXCHANGE

Tendency Uncertain; I.C.I. "New" Freely Sold, Ultimately Firming Up to 29/-

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 1 JULY +RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	20/6	9	10	8 15 6	21/3	17/9	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6	4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	49/9	15	15	6 0 9	51/–	47/–	72/3	47/9
1,590,000	1	Birfield Industries	49/6	15	15	6 1 3	53/9	46/3	70/–	48/9
3,196,667	1	Birmid Industries	67/6 +6d.	17½	17½	5 3 9	68/–	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	27/7½ —6d.	10	8	7 4 9	28/6	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/4½	5	5	6 10 0	15/7½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/7½	6	6	7 4 3	17/–	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	25/–	12½	12½	10 0 0	28/9	25/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/6	5	5	6 9 0	16/–	15/3	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/4½ +4½d.	7	7	7 4 6	19/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	43/9 —3d.	12	12	5 9 9	46/6	37/–	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/–	6	6	6 6 3	19/3	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	43/3 —1/6	12½	12½	5 14 3	45/6	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	34/6 —9d.	10	10	5 16 0	35/3	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	20/–	25+*2½C	25	6 5 0	21/–	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/9	25	25	10 0 0X	2/3	1/9	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/3	25	25	11 16 3	4/9	4/1½	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	18/– +3d.	10	10	11 2 3	18/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/9 +1½d.	6	6	7 12 6	15/10½	15/7½	17/6	16/–
250,000	2/–	Coley Metals	2/9	20	25	14 11 0	4/6	2/9	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	47/6 —1/–	18¾	22½	7 18 0	51/6	42/6	92/6	49/–
1,136,233	1	Davy & United	51/3 +9d.	15	12½	5 17 0	51/3	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	20/6 +3d.	30	*17½	7 6 3	21/4½	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	33/– —1/–	12½	15B	7 11 6	34/–	24/–	38/6	25/–
750,000	1	Evered & Co.	27/6xcap	15Z	15	7 5 6	28/3	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	32/– —1/6	12½	14	7 3 9Y	38/7½	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	30/9 —2/–	20	17½	6 10 0	33/9	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	63/9 —1/3	15	15	4 14 0	66/3	63/9	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	5/9 —3d.	11½	11½	10 0 0	6/6	5/7½	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	14/1½ +4½d.	20	20	7 1 6	14/1½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	24/3 —3d.	13¾	18Z	5 7 3	24/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	49/3 +2/6	20	17½	8 2 6	49/3	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	13/3	*15	*15	5 13 3	13/3	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	18/9	7	7	7 9 3	19/–	18/9	22/3	18/7½
1,075,167	5/–	Heenan Group	7/6 +3d.	10	20‡	6 13 3	7/7½	6/9	10/4½	6/9
216,531,615	Stk. (£1)	Imperial Chemical Industries ...	28/9xcap —1/–	12Z	10	5 11 4	30/4½	27/9	46/6	36/3
33,708,769	Stk (£1)	Ditto Cum. Pref. 5%	16/6 —1½d.	5	5	6 1 3	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	143½ —1½	$3.75	$3.75	4 13 9	148½	132‡	222	130
430,000	5/–	Jenks (E. P.), Ltd.	8/– —1½d.	27½¢	27½	8 12 0	8/3	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3	5	5	6 3 0	16/3	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	44/– —1/6	10	9	4 11 0	44/–	37/6	58/9	40/–
600,000	10/–	Keith, Blackman	20/– +2/6	17½	15	8 15 0	20/–	15/–	21/9	15/–
160,000	4/–	London Aluminium	4/4½ +3d.	10	10	9 2 9	4/4½	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	44/6 —6d.	12½	12½	5 12 3	45/–	39/9	54/6	41/–
400,000	1	Ditto Pref.	23/3	7½	7½	6 9 0	23/3	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	32/6	15	15	9 4 6	35/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	31/3	15	15	9 12 0	32/6	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	9/6	20	27½‡	10 10 6	10/6	9/–	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–	7½	7½	7 10 0	6/3	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	51/3 —3d.	11	11	4 5 9	51/6	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	7/1½	50	50	14 0 9	7/1½	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	20/–	10	10	10 0 0	22/9	20/–	25/–	21/6
80,000	5	Ditto Pref. 6%	81/6	6	6	7 7 6	83/6	81/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	37/6 —6d.	10	10	5 6 9	48/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st. Pref. ...	17/–	5½	5½	6 9 6	17/3	17/–	19/3	16/–
2,200,000	Stk. (£1)	Murex	56/3 —2/6	20	20	7 2 3	58/9	53/3	79/9	57/–
468,000	5/–	Ratcliffe (Great Bridge)	8/7½	10	10	5 16 0	8/7½	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	25/9	20	27½D	7 15 3	27/–	25/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	13/1½ —1½d.	17½Z	15	4 9 0	13/3	11/–	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	51/6 +3d.	16	16	6 4 3	51/6	43/9	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	19/6	6½	6½	6 13 3	20/9	19/6	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	54/9	15	15	5 9 6	55/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	30/–	10	10	6 13 3	32/6	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–	5	5	6 13 3	15/6	14/9	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/3	*5	*5	7 4 9A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	77/3	20	15	5 3 6	77/3	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	39/– —1/–	10	18P	5 2 6	40/–	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	7/1½	25	40	7 0 3	8/–	7/1½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	18/– +4½d.	27½	27½	7 12 9	18/–	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/6	20	17½E	14 5 9	3/9½	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/3	6	6	10 13 3	11/6	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/1½	40D	33½	8 10 9	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized Issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ||Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ¢ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.